

Digital Fabrication 2005



September 18-22
Baltimore, MD

Co-located with NIP21

Preliminary Programs

NIP21



**21st International Conference on
Digital Printing Technologies**

September 18-23
Baltimore, MD

Co-located with
Digital Fabrication 2005



Sponsored by:

The Society for Imaging Science and Technology (IS&T)

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Welcome to the joint Preliminary Program for Digital Fabrication 2005 and NIP21!

The colocation of these meetings offers a unique opportunity for attendees to take advantage of two great conferences by mixing and matching technical sessions of interest. Colocation allows IS&T the ability to give participants a rich array of tutorials to choose from and a high-quality exhibit to visit, not to mention exciting and timely keynotes, a special panel on intellectual property, and Print and Art & Textile galleries where the latest printing technologies and what they are being used for can be seen and compared. Registrants for either conference have admission to the other.

To facilitate planning your time in Baltimore, we've color coded the pages of this booklet as noted below. In addition, you can use the listing below to navigate your way through the booklet.



Digital Fabrication 2005 Conference



NIP21 Conference



Joint Sessions/Tutorials: Digital Fabrication 2005 and NIP21

Table of Contents

Digital Fabrication

Program-at-a-Glance	1
Conference Committee	2
Conference Highlights	2
Technical Program	3

Joint Sessions and Events: NIP 21/Digital Fabrication 2005

The Venue: Baltimore, Maryland	6
Keynotes	7
Panel Discussion: Intellectual Property	8
Print and Art & Textile Galleries	8
Tutorials Program	9
Conference Week At-a-Glance	16
How to read the Schedules	22

NIP 21

Conference Committee	22
Program-at-a-Glance	23
Technical Program	24

Conference Registration	32
Hotel Registration	33

Digital Fabrication Program-at-a-Glance

Announcing IS&T's Newest Conference!

Join us in Baltimore to participate in Digital Fabrication 2005, the inaugural international conference on digital fabrication technologies. Digital Fabrication 2005 is collocated with NIP21 and as such provides a unique opportunity for technical professionals in both fields to discuss the advances, synergies, and directions.

Over the past few years, digital and non-impact printing technologies have enabled new fabrication methods, materials, and applications. By exploiting both traditional non-impact and new printing approaches, it is now possible to pattern and print two- and three-dimensional structures at physical scales ranging from nanometers to meters. Recent work has shown the ability to digitally fabricate a wide variety of devices including electronic circuits, MEMs and NEMs structures, architectural components, and even biologically-engineered structures. These methods are finding applications in all areas of prototyping, fabrication, and commercial applications—from the laboratory bench to the manufacturing floor. A comprehensive program of invited and contributed papers from leading scientists and engineers is planned along with keynote addresses, tutorials, and an exhibition of digital fabrication related products, materials, and equipment.

Some highlights of Digital Fabrication 2005 are:

- The Tutorial Program, which takes place Sunday through Wednesday and offers 25 tutorials in many subjects. Detailed descriptions can be found in the program beginning on page 9, a list of those of particular interest to Digital Fabrication 2005 attendees is found on page 2.
- Keynote Addresses by international industry leaders and scientific experts from Xerox Supplies, Osaka University, MIT, and the Paul-Scherrer Institute to begin most conference days.
- Collocation with NIP21, the preeminent forum for discussions of advances and directions in non-impact and digital printing technologies. Collocation and co-technical programming will allow Digital Fabrication 2005 and NIP21 attendees the opportunity to participate in both conferences and take advantage of a comprehensive program of contributed papers from leading scientists and engineers, sessions of invited papers on special topics, panel discussions, and a print gallery.
- A Technical Program featuring more than 60 contributed and invited papers covering digital fabrication processes, materials, and applications. (NIP21 will feature more than 180 papers and 20 sessions broadly covering non-impact and digital printing technologies.)
- Four Special Topics sessions with invited presentations by experts in the areas of Digital Art, Production Digital Printing, Sensors in Imaging, and Nanotechnology in Imaging Science and Instrumentation.
- Presentation of the IS&T Chester F. Carlson Award to Inan Chen for his contributions to the science and technology of electrophotography on Monday morning after the keynote.
- Poster Session that provides an opportunity for one-on-one interaction with the authors; light refreshment will be served.
- NIP21/Digital Fabrication 2005 Exhibition, open Tuesday and Wednesday, showcasing a wide range of products, applications, and services related to printing, imaging, and digital fabrication.
- Wednesday afternoon, a Panel Discussion on Intellectual Property, featuring international experts on topics of valuation, protection and litigation, trademarks, brand protection, and patent law.
- An Ice Breaker Reception on Sunday evening and Conference Reception on Wednesday evening at which to meet colleagues and network.

If you work in the field of digital fabrication or related technologies, Digital Fabrication 2005 is the conference to attend!

Conference Highlights

NIP21/Digital Fabrication 2005 Exhibition

(located at the Hyatt Regency Baltimore)

The exhibition will be open on Tuesday from 9:30 am to 5 pm and Wednesday from 9 am to 4 pm. Please join us and visit the exhibitors listed on page 10.

Special Session

Nanotechnology in Imaging Science and Instrumentation

This session addresses instrumentation that helps one understand the properties of very small structures, particles, and surfaces that may lead to unexpected advances in material design and fabrication. For details, see page 8.

Tutorials of Special Interest

Twenty-five tutorials taught by world-renowned experts, will be offered during Digital Fabrication 2005/NIP21. All classes will be held at the Hyatt Regency Baltimore. Complete descriptions for each class can be found beginning on page 9. Separate registration for classes is required (see registration form, page 34). The following is a list of classes that may be of particular interest to Digital Fabrication 2005 attendees:

Sunday

T01 – Introduction to Toner Technology

Instructor: George Marshall, Lexmark International, Inc.

T02 – An Overview of Ink Jet Printing from an Ink Perspective

Instructor: Alan Hudd, Xennia Technology Ltd.

T03 – Paper-like Displays

Instructor: Tom Ashley, Pivotal Resources USA

T04 – Introduction to Electrophotography

Instructor: Lawrence B. Schein, Consultant

T05 – Managing R&D Projects for Value

Instructor: George Gibson, Xerox Corporation

T07 - Fabrication Materials and Processes of Ink Jet Printheads

Instructor: Hue Le, Picojet, Inc.

T10-Introduction to Organic Electronic Materials and Devices

Zoran D. Popovic and Tim Bender,
Xerox Research Centre of Canada

Monday

T11 – Direct-Write Technologies for Rapid Prototyping Applications: Sensors, Electronics, and Power Sources

Instructor: Douglas B. Chrisey, US Naval Research Lab.

T13 – Organic Photoreceptors for Digital Electrophotographic Printers

Instructor: David Weiss, NexPress Digital L.L.C.

T14 – Physics of Organic Elec- trophotographic Photoreceptors

Instructor: Andrew Melnyk, Consultant

T16 – Papermaking, Coating Fundamentals, and Media for Digital Printing

Instructor: Sen Yang, International Paper

Tuesday

T21 – Electrostatic Toner Transfer

Instructor: Thomas N. Tombs, NexPress Solutions, Inc.

T22 – Electrostatics and Particle Adhesion in Electrophotography

Instructor: Dan A. Hays, Xerox Corporation

T23 – Evaluating Ink Jet Technology

Instructor: Ross N. Mills,
imaging Technology international (iTi) Corporation

T24 – Chemical Toners

Instructor: Grazyna Kmiecik-Lawrynowicz,
Xerox Corporation

Conference Committee

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Digital Fabrication Technical Program

Tuesday September 20, 2005

8:10 am to 12:10 pm

Digital Fabrication Processes

Session Chairs: Alfred Pan, Hewlett-Packard Company (Americas); Werner Zapka, XAAR (Europe); Masaya Ishida, Epson Cambridge Laboratory UK (Asia)

Opening Comments, Announcements and Remarks, James Stasiak, General Chair
Digital Fabrication 2005

Ink Jet Tools for Precision Fabrication (Focal), Linda T. Creagh and Martin W. Schoeppler, Spectra, Inc. (USA)

Materials and Process Development for Digital Fabrication Using Ink Jet Technology (Invited), Ross N. Mills, William F. Demyanovich, and Eric D. Hybertson, Imaging Technology International Corporation (USA)

Jet-printing of Active-Matrix Thin Film Transistor Backplanes for Displays and Sensors (Invited), Robert Street, William Wong, Steven Ready, R. Lujan, and A. Arias, Palo Alto Research Center (USA)

New Drive Electronics to Improve Drop Weight Uniformity in Multi-Nozzle Inkjet Heads (Oral), Shinya Kobayashi and Kida Hitoshi, Ricoh Printing Systems, Ltd. (Japan)

Novel Concepts in Mesoscale Direct Writing of Sensors and Electronics (Oral), Sanjay Sampath, Center for Thermal Spray Research, State University of New York (USA)

Nanoxerography: Electrostatic Force Directed Printing of Nanomaterials (Focal), Chad R. Barry, Steven Campbell, and Heiko O. Jacobs, University of Minnesota (USA)

A Study of Digital Fabrication Using High-resolution Liquid Toner Electrophotography (Oral), Atsuko Iida, Yasushi Shinjo, Koichi Ishii, Hitoshi Yagi, Mitsunaga Saito, Naoko Yamaguchi, and Masahiro Hosoya, Toshiba Corporation (Japan)

1:00 to 5:40 pm

Digital Fabrication Processes (con't.)

Session Chairs: Jennifer Lewis, University of Illinois Urbana/Champagne (Americas); Werner Zapka, XAAR (Europe); and Masaya Ishida, Epson Cambridge Laboratory UK (Asia)

Printing Techniques for Macroelectronics (Focal), John A. Rogers, University of Illinois (USA)

Printing Processes for Functional Electronic Manufacture (Invited), Robert Detig, Electrox Corp. (USA)

Metal Printing Process — Challenges and Potentials (Oral), Øyvind Kolnes, Terje Mugaas, Casper van der Eijk, Olav Åsebø, Roald Karlsen, and Rune Skjvedal, Applied Cybernetics (Norway)

Photo Ceramic Relief Imaging (Oral), David Huson, Stephen Hoskins, and Paul Thirkell, University of the West of England (UK)

Production of Sintered Ceramic Patterns Using an Inkjet Printing Process (Oral), Wolfgang Voit and Werner Zapka, XaarJet AB (Sweden); Frederic Moscou, Cerlase (France); Kjell Broström, XaarJet AB (Sweden); and Sebastien Verilhac, Lamberti Specialty Chemicals (France)

Dip-Pen Nanolithography for Templated Assembly with Biomaterials and Organic Films (Invited), David S. Ginger, University of Washington (USA)

Dip-Pen Nanolithography Techniques for Patterning of Biological Catalysts (Invited), Laura A. Sowards, Kristi M. Singh, Morley O. Stone, and Rajesh R. Naik, Materials and Manufacturing Directorate, Wright-Patterson Air Force Base (USA)

Direct Deposition of Electronic Materials with Thermal Dip-Pen Nanolithography (Invited), Paul E. Sheehan, M. Yang, and A. Laracuenté, Naval Research Laboratory; B.A. Nelson and W. P. King, Georgia Institute of Technology; and L. J. Whitman, Naval Research Laboratory (USA)

Nanoscale Patterning of Organic and Metallic Features on Semiconductors via Self-Assembly of Soft Materials (Invited), Jillian M. Buriak, University of Alberta (Canada)

7:00 to 9:00 pm

Interactive Paper Session

Session Chair: Alfred Pan, Hewlett-Packard Company (Americas)

Presentations that will benefit from a closer scrutiny of image results have been assigned to poster session presentation. This alternative presentation style is always a highlight of the conference and a great opportunity for one-on-one discussion with authors. Presenters will stand by their poster paper displays during this session to discuss their work with you. Light refreshments will be served.

Digital Fabrication Devices and Applications

Parameters for Evaluating Tactile Structures Produced with Ink-jet, Don McCallum, Jonathan Rowell and Snir Dinar, Anglia Polytechnic University (UK)

Using Unique Sequenced Drop Placement (SDP) with Inkjet to Produce Different Cross-sectional Profiles in Tactile Maps, Snir Dinar, Jonathan Rowell, Don McCallum and George B. Wilson, Anglia Polytechnic University (UK)

Image Segmentation and Optimal Routing of Ink Jet Printing of Electronic Circuits (Oral), Chih-Hsuan Chiu, Chih-Jian Lin, Ming-Huan Yang, Jane Chang, Jinn-Cheng Yang, and Kevin Cheng, Industrial Technology Research Institute (Taiwan)

Circuit Fabrication by Ink-jet Printing on Hybrid-multilayer Polyelectrolytes (Oral), Ming-Huan Yang, Chung-Wei Wang, Jane Chang and Kevin Cheng, Industrial Technology Research Institute (Taiwan)

Ink-Jet Printed Passive Electronic Components: Metal-Insulator-Metal and Metal-Resistor-Metal (Oral), Sha-Man Wang, Albert Chen, Chung-Ping Liu, Chung-Wei Wang, Ming-Huan Yang, Kevin Cheng and Jane Chang, Industrial Technology Research Institute (Taiwan)

Digital Fabrication Materials

Continuous Roll-to-Roll Circuit Fabrication by Ink Jet Printing Process, Wanda W. W. Chiu, Kuo-Hua Wu, Jie-Kai Chang, Ming-Huan Yang, Chung-Wei Wang, Jane Chang and Kevin Cheng, Industrial Technology Research Institute (Taiwan)

Fabrication of Electrical Circuit Using Pd Colloid Particle, Toshihiko Oguchi and Keiki Suganami, Morimura Chemicals Ltd. (Japan)

Surface Characteristics of Ink-Jet Printing of Circuits by Polyelectrolyte Multilayers with Salt Solution, Chung-Wei Wang, Ming-Huan Yang, Jane Chang and Kevin Cheng, Industrial Technology Research Institute (Taiwan)

Digital Fabrication Processes

Tunable Resolution and Patterning Method for Ink-Jet Printing Process, Chih-Jian Lin, Yung-Kuo Ho, Elvis Wu, Chia-Ming Chang, Kuo-Hua Wu, Chieh-Yi Huang, Jane Chang and Kevin Cheng, Industrial Technology Research Institute (Taiwan)

Ink-Jet Printing of Silver Conductive Patterns for Flexible Electronics, Donjo Kim, Jungho Park, Sunho Jeong and Jooho Moon, Yonsei University (Korea)

3D Printing of Biological Materials for Drug Delivery and Tissue Engineering Applica-

tions, Delia Radulescu, Hans-Jochen Trost, David T. Taylor and Bogdan Antohe, MicroFab Technologies, Inc.; Nathan D. Schwade, Los Alamos National Laboratories; Peter J. Tarcha, Abbott Laboratories; David Silva, MicroFab Technologies, Inc.; Christine M. Young, Sanjay Dhar and Gregory R. D. Evans, University of California, Irvine (USA)

Evaluating the Compatibility and Life Time for Discharging Catalyst by Piezo-Head, Chi-Ming Huang, Ming-Huang Yang, Chung-Wei Wang, Fa-Yuan Hsu, Ching-Yi Mao and Chun-Jung Chen, Industrial Technology Research Institute (Taiwan)

Fabrication of High-Resolution Colloidal Crystal Array on Patterned Substrates by Ink-Jet Printing, Jungho Park, Hyunjung Shin and Jooho Moon, Yonsei University (Korea)

Fabrication of Organic Transistor Based on Ink-Jet Printed Copper Electrodes, Sunho Jeong, Dongjo Kim and Jooho Moon, Yonsei University (Korea)

Hybrid Digital Fabrication Method of Micro Patterns Coupled with Inkjet Printing and Photolithography, Chin-Tai Chen, Ching-Long Chiu and Zhao-Fu Tseng, Industrial Technology Research Institute (Taiwan)

Structure and Ink-Jet Printing Process of Organic Memory, Chao-Feng Sung, Ji-Ping Hu, Jane Chang, Ti-Fa Ying and Yang Yang, Industrial Technology Research Institute (Taiwan)

Wednesday September 21, 2005

8:00 to 9:00 am

Joint NIP21/Digital Fabrication 2005 Keynote

Hyatt Regency Baltimore

Session Chair: James Stasiak, Hewlett-Packard

Bits and Atoms

Neil Gershenfeld, MIT (USA); see abstract and biography on page 7.

9:20 to 12:20 pm

Digital Fabrication Devices and Applications

Session Chairs: Thomas Boland, Clemson University (Americas); Wolfgang Mildner, PolyIC (Europe); and Mutsumi Kimura, Ryukoku University (Asia)

The Current Situations and Future Applications of Inkjet Industry (Focal), Hiroshi Kiguchi, Seiko Epson Corporation (Japan)

Recent Progress in Nonlithographic Patterning and Printing of Nano-thick Functional Materials and Devices (Invited), Yuka Yoshioka, and Ghassan E. Jabbour, Arizona State University (USA)

Computer-Aided Tissue Engineering and Its Application For Freeform Fabrication of Tissue Substitutes (Invited), *Wei Sun, Drexel University (USA)*

Printed RFID Labels Based on Polymer Electronics (Invited), *Alexander Knobloch, Kurz GmbH & Co. KG (Germany)*

Variable Data Security Printing and the "Layered" Deterrent (Oral), *Steven Simske and Roberto Falcon, Hewlett-Packard Company (USA)*

1:30 to 4:20 pm

Digital Fabrication Devices and Applications (con't.)

Session Chairs: Alfred Pan, Hewlett-Packard Company (Americas); Wolfgang Mildner, PolyIC (Europe); and Mutsumi Kimura, Ryukoku University (Asia)

Thermal Ink Jet Printing of Electronics Devices and Circuits (Invited), *David Punsalan, John Thompson, Chinmay Betrabet, Peter Mardilovich, Randy Hoffman, Gregory Herman, and Thomas Lindner, Hewlett-Packard Company (USA)*

Large Area Distributed Electronics (Invited), *Robert Reuss, DARPA/MTO (USA)*

Laser Direct Imaging — Towards a Universal Tool for Display Manufacturing (Oral), *Eran Elizur and Dan Gelbart, Creo Inc. (Canada)*

On-Demand Pixel Arrangement for Flat Panel Displays (Invited), *Mutsumi Kimura and Akihiko Tsunoya, Ryukoku University (Japan)*

From Rapid Prototyping to Rapid Manufacturing (Invited), *Manfred Hofmann, RPC Ltd. (Switzerland)*

Novel Inks for Direct Writing in Three Dimensions (Invited), *Jennifer A. Lewis, University of Illinois at Urbana-Champaign (USA)*

Please note:

Panel Discussion: Intellectual Property

takes place from 4:15 – 6 pm at the Hyatt Regency Baltimore on Wednesday, September 21st.

The panel will address the impact of national and international law on innovation in imaging and important aspects in patent, copyright and trademark protection. For more details see page 8.

4:50 to 6:10 pm

Digital Fabrication Devices and Applications (con't.)

Hot Melt Inks for 3D Printing (Oral), *Veronika Chovancova, Alexandra Pekarovicov, and Paul D. Fleming III, Western Michigan University (USA)*

3-D Powder Deposition onto Pharmaceutical Tablets (Oral), *J. Randolph Sanders and Peter Mason, Torrey Pines Research (USA); and Marshall Whiteman, Phoqus (UK)*

Direct 3D Laser Writing by Two-Photon Illumination (Oral), *A. Ovsianikov and Boris N. Chichkov, Laser Zentrum Hannover e.V. (Germany)*

Design and Fabrication of 3D Microlens Array by Solvent-type Polymer of Inkjet Printing (Oral), *Chin-Tai Chen, Ching-Long Chiu, Yen-Wen Sha, Yung-Fa Huang, Zhao-Fu Tseng and Chun-Te Chuang, Opto-Electronics & Systems Laboratories, Industrial Technology Research Institute (Taiwan)*

Thursday September 22, 2005

8:10 to 11:50 pm

Digital Fabrication Materials

Session Chairs: Thomas Boland, Clemson University (Americas); Susanne Heun, Covion (Europe); and Junichi Hanna, Tokyo Institute of Technology (Asia)

Inkjettable Electronic Materials for Flat Panel Display and Passive Component Manufacture (Focal), *James Caruso, Karel Vanheusen, Mark Kowalski, and Chuck Edwards, Cabot Corporation (USA)*

Ink Jet Printed Metals and Conducting Polymers (Invited), *Calvin J. Curtis,¹ Tanya Kaydanova,¹ Alex Miedaner,¹ Maikel F. A. M. van Hest,^{1,2} Lee Smith,² Andrew Leenheer,² Eric Garnett,¹ Reuben T. Collins,² and David S. Ginley;¹ ¹National Renewable Energy Laboratory and ²Colorado School of Mines (USA)*

Functional Biomimetic Microlens Arrays with Integrated Pores (Invited), *Shu Yang, University of Pennsylvania (USA)*

Ink-Jet Deposition of Materials for MEMS Fabrication (Oral), *David Wallace, Donald Hayes, Ting Chen, Virang Shah, Delia Radulescu, Patrick Cooley, Kurt Wachtler, and Arunkumar Nallani, The University of Texas at Dallas (USA)*

3D Ink Jet Printing of Ceramics and Biomaterials (Invited), *Brian Derby, University of Manchester (UK)*

Drop-on Demand Printing of Cell and Materials for Designer Hybrid Cardiovascular Biomaterials (Invited), Tao Xu, Sahil Jalota, Brian Manley, Sarit Bhaduri, Michael Zile, and Thomas Boland, Clemson University; and Catalin Baicu, Medical University of South Carolina (USA)

1:00 to 5:40 pm

Digital Fabrication Materials (con't.)

Solution-based, Low-temperature Deposition of Oxide Thin Films for Electronics (Invited), Jeremy Anderson, Stephen Meyers, Douglas A. Keszler, Craig Munsee, John Olson, and John F. Wager, Oregon State University; Tran Phung and David C. Johnson, University of Oregon; and Gregory S. Herman, Hewlett-Packard Company (USA)

High Performance Nanomaterials-based Printed Semiconductor (Invited), Hou-T Ng and Alfred Pan, Hewlett-Packard Company (USA)

Individually Dispersed Nanoparticle Ink for Film Formation using Inkjet (Invited), Masaaki Oda, Hiroshi Yamaguchi, Noriyuki Abe, Tsutomu Atsuki, Kyuukou Tei, Masaki Kitazaki, and Sadayuki Ukishima, Ulvac Corporation (Japan)

A Combinatorial Approach to Identification of Catalysts for the Photoelectrolysis of Water (Invited), Michael Woodhouse, G. S.

Herman, and B. A. Parkinson, Colorado State University (USA)

Nanocolloid Quantum Dot Inks for Ink Jet: Recent Developments and Potential Applications (Oral), John Oliver, Innov8 Solutions (Canada)

The Properties of Polymer Blends of Polyani-line and Lignin (Oral), Erika Hrehorova, Jan Pekarovic, Alexandra Pekarovicova, Paul D. Fleming, Valery Bliznyuk, and Laura Wood, Western Michigan University (USA)

Jet Flows of Amorphous Borate Esters for Ink Jet Printing (Oral), Sam Ahuja, Xerox Corporation, and Tom Smith, Rochester Institute of Technology (USA)

Exploring Nano-Silicon for Printable Electronics (Oral), Juergen Steiger, T. Lüthge, F.-M. Petrat, R. Anselmann, and B. Schleich, Degussa, Creavis Technologies and Innovation (Germany)

Process of Forming Micropattern Imaging with "Liquid" Nano Carbon (Oral), Khe C. Nguyen, Saigon Hi-Tech Park; L.V. Thang and D. M. Chien, University of Technology/Ho Chi Minh City; and V.H. Nham, University of Can Tho (Vietnam)

Printing Electronic Materials (Invited), John Szczzech, Jie Zhang, Krishna Kalyan, Paul Brazis, and Daniel Gamota, Motorola Corporation (USA)

Venue

Baltimore, Maryland

Baltimore is a dynamic city that continues to evolve while holding on to its maritime heritage. The port of Baltimore lies farther west than any other major Atlantic port and more than 30 million tons of cargo pass through it every year.

The Sheraton Inner Harbor (headquarter hotel for Digital Fabrication 2005) and Hyatt Regency Baltimore (headquarter hotel for NIP21) are located just steps away from each other. The Inner Harbor is the crown jewel of the city and home to the National Aquarium, Maritime Museum, Maryland Science Center, and USS Constellation, the last all-sail warship built by the US Navy. There are plenty of dining and shopping opportunities at the nearby, as well as within the easily-reached,

charming historic neighborhoods that make up the city. Each area offers unique character, history, and cuisine.

Fells Point was Baltimore's original seaport and home to the first shipyards, while Little Italy charms with the aroma of fresh baked bread. Mount Vernon, Baltimore's cultural center, is boasts the first architectural monument to George Washington; Peabody Conservatory of Music; and Walters Art Gallery. Art lovers should visit the Baltimore Museum of Art, home of the internationally-acclaimed Cone (impressionist) Collection. Baltimore is also the home of the Ravens and Orioles, and the historic Camden Yards Baseball Stadium is located a few blocks from the headquarter hotels.

Joint Sessions and Events: NIP 21/Digital Fabrication 2005

Keynotes

Monday September 19, 2005, 8:00 to 9:00 am

Materials for Digital Printing

John R. Laing, Xerox Corporation

With the advancement in microprocessors and nano-technologies, non-impact printing has transitioned from analog to digital and is migrating from monochrome to color. Digital color printing offerings have extended from the home and office to the production-printing segment. Digital color printing technologies have continually evolved in an effort to meet the intense customer demand for lower price per page, greater reliability/image quality, and a broad range of applications. These advances could not have been made without the critical role that xerographic materials have played. Life extensions with the ability to achieve high toner transfer efficiency and cleanability for photoreceptor and intermediate transfer belt has been an intense focus in this industry. The rapid expansion of chemical toner technologies has enabled new applications and offered new opportunities. This talk reviews the market trends in printing, the technological challenges of meeting the market requirements, and the material developments that have supported digital color printing advances.

John R. Laing, senior vice president of the Supplies Delivery Unit within the Xerox Supplies Business Group, is responsible for the multinational design, development, manufacturing, and sourcing of toner, developer, photoreceptor, print cartridge, and fuser products. Laing joined Xerox in 1977 in the technology group designing toner materials. Since then he has held a variety of technical and management positions. In 1988 he won the Xerox President's Achievement Award. He received a BSc in Mathematics and Chemistry from the University of Toronto; a PhD in Chemical Physics from the University of Chicago; and an MBA from the University of Rochester. He has issued 19 scientific publications and has been awarded 13 US patents.

Wednesday, September 21, 2005, 8:00 to 9:00 am

Bits and Atoms

Neil Gershenfeld, MIT

Digital revolutions have occurred in communications and computation, but not yet fabrication. Computers control machines that make computers, but a \$10-billion chip fab still uses fundamentally analog materials. Biology provides an alternative model based on programmed assembly of molecular building blocks, offering the same kind of reliability thresholds that en-

able digital communications and computation. This talk will present research on fabrication technologies that are fundamentally digital that merge computation with construction, and illustrate their implications in both developed and developing countries through early access to prototype tools for personal fabrication.

Neil Gershenfeld is director of MIT's Center for Bits and Atoms. His unique laboratory investigates the relationship between the content of information and its physical representation, from molecular quantum computers to virtuosic musical instruments. Technology from the lab has been seen and used in settings from New York's Museum of Modern Art to rural Indian villages, from the White House/Smithsonian Millennium celebration to automobile safety systems, from the World Economic Forum to inner-city community centers, and from Las Vegas shows to Sami reindeer herds. Gershenfeld is the author of numerous technical publications, patents, and books including "Fab", "When Things Start To Think" "The Nature of Mathematical Modeling," and "The Physics of Information Technology." He has been featured in The New York Times and The Economist and on CNN, and the McNeil/Lehrer News Hour. He holds a BA in Physics with High Honors from Swarthmore College, a PhD from Cornell University, was a Junior Fellow of the Harvard University Society of Fellows, and is a member of the research staff at Bell Labs.

Thursday September 22, 2005, 8:00 to 9:00 am

OPC as Imaging Materials — Glorious Past and Promising Future

Masaaki Yokoyama, Osaka University, Japan

About the time the 2000 Nobel Prize in Chemistry was awarded for the discovery and development of conductive polymers, a group of organics called organic semiconductors began to attract a great deal of attention for electronic materials. Over the past three decades, following many years of effort, organic electronic materials, namely Organic Photoconductors (OPCs), have achieved great success as electrophotographic photoreceptors in copy machines and laser beam printers. Deep understandings in the area of charge generation and transport, as well as charge injection at the interface of organic layers in organic photoreceptors, established the fundamentals of electronic processes in a wide range of organic materials that consisted of inherently insulating molecular assembly. Recently flagged as "organic electronics," these materials have become part of many electronic devices, such as organic electroluminescent EL devices, and more recently, organic FET transistors, organic memories, and solid state organic solar cells. Great efforts have

been devoted to achieve paper-like displays or electronic papers, exploiting their advantages for large area, flexible devices. In this talk, the historic progress of OPCs will be reviewed briefly; the future of organic electronic materials will be considered—in light of the fact that they are generally said to be inferior to inorganic silicon semiconductors in their electrical properties—and a scenario to an advanced imaging world drawn with organic electronics will be discussed, as will a recently developed novel opto-electronic device combining an organic EL diode and organic photo-electrical conversion layer, if time permits.

Masaaki Yokoyama, professor at Osaka University, received his BSc (1966), MSc (1968) and PhD (1971) in polymer science from Osaka University. Since 1971 he has been a member of the faculty of Engineering in the Graduate School of Engineering at Osaka University, becoming a professor in 1987. His work focuses on the development of organic photoreceptor materials and device applications. His current interests involve the research of organic electronics and their application to new optoelectronic and photonic devices. Yokoyama was a past president of the Imaging Society of Japan (ISJ, 2000-2001). He is an IS&T Fellow (1994) and received ISJ's Technical Award in 2001 and Society Award in 2003.

Friday September 23, 2005, 8:00 to 9:00 am

Nano-Imaging: From Science to Technology

Thomas A. Jung, Laboratory for Micro- and Nanostructures and Paul Scherrer Institute (PSI), Switzerland

Nanoscience by itself is to a large extent an imaging science where complex information about ultimately small pieces of matter is mapped into multi-dimensional arrays. Nano-imaging goes far beyond microscopic projection images and has contributed to the evolution of mankind's scientific understanding that is continuously rolling over into technology. This talk will first address the use of nano-imaging to explain some of the recent breakthroughs in nanoscience before describing selected examples for the transfer of nano-science into nano-technology. It will close with a rather personal look at future developments and long-term visions.

Thomas A. Jung is a research group leader at the Paul Scherrer Institute (PSI), which is a member institution of the domain of the Federal Institute of Technology, Switzerland, where he works in the field of nanometer-scale science and technology, in particular nanomechanics, molecular switching and molecular nanoscale devices. Since 1999 he has headed the 'Nanolab' at the University of Basel, where he gives lectures and supervises students and postdocs. Jung joined the IBM T.J. Watson Research Laboratory as a Post-Doctoral Fellow (1992) to work on scanning tunnelling microscopy and spectroscopy of metallic wires and islands. From 1994-1997 he explored

interfaced molecular nanostructures while working at IBM's Zurich Research Laboratory, where molecular positioning was achieved for the first time at room temperature and unique methods for the identification and analysis of an individual molecules' conformation were demonstrated. Jung received a Diplom degree in solid state physics and biophysics from the Swiss Federal Institute of Technology (1987) and a PhD in solid state physics and surface physics from the University of Basel (1992).

Wednesday, September 21, 4:15 – 6 pm

Panel Discussion: Intellectual Property

Panel Organizer: Yee S. Ng (NexPress Solutions, Inc., a Kodak Company)

Moderator: Russell Barron (Partner, Foley & Lardner)

Panelists: Richard Bero (Managing Director, Corporate Financial Advisors); David A. Latham (Partner, Lovells, UK); Winfried G. Schmid (Director Directorate 2.2.12, European Patent Office); and Ming Xu (CTO, Sawgrass Technologies)

The panel will address the impact of national and international law on innovation in imaging and important aspects in patent, copyright and trademark protection. See the NIP21 web page (www.imaging.org/conferences/nip21/) for profiles of presenters.

Monday September 19, 2005, 5:00 to 6:30 pm

Print and Art & Textile Galleries

The Print Gallery allows an up-close, detailed look at the performance capabilities and relative advantages of various printing technologies on paper and traditional media. A test image will be provided for benchmarking. You are invited to submit print samples to showcase your product(s) and/or technology(ies). Print Gallery exhibitors will be able to exchange prints and take home a collection of the latest samples.

The Art & Textile Gallery will be held in conjunction with NIP21 sessions on Digital Art and Industrial and Textile Printing to showcase how artists and textile printers use digital print and new imaging materials.

On Monday from 5 – 6:30 pm presenters will be available at the Gallery for discussion; samples will be displayed Monday through Wednesday. For more information, the standard print file (for the Print Gallery), and space reservations, contact Huoy-Jen Yuh (Huoy-Jen.Yuh@usa.xerox.com).

Tutorial Program

Note: The conference sponsors reserve the right to cancel tutorial classes in the event of insufficient advance registration. Please indicate your interest early. Prerequisites for advanced classes are noted in the description.

T01 – Introduction to Toner Technology

Sunday 8:00 am to 12:00 noon (4 hours)

Instructor: George Marshall,
Lexmark International, Inc.

This course will include an introduction to electronic printing technologies and define the place of electrophotography in its various embodiments. One common element—toner—will be discussed in terms of architecture, formulation, and implementation in each of these embodiments. Various toner design criteria and performance requirements will be discussed. Analytical and measurement techniques will be surveyed, including size, charge, and rheological attributes. Recent product introductions will be reviewed, and present and future trends in toner technology will be discussed. A glossary and bibliography for future reference will also be provided.

Benefits: This course will enable the attendee to:

- Understand the various implementations of electrophotographic printing and the role that toner plays
- Recognize the design criteria and performance requirements of toner in an EP printing subsystem
- Comprehend toner manufacturing alternatives for commercial devices
- Compare the market implementation of various toner technologies and the potential for future market domination

Intended Audience: This course is directed toward anyone seeking an introduction to electrophotography, electrophotographic printing, supplies technology, or related development activities. An interest in toners or carriers is helpful. No working knowledge of electrophotography is presumed or required.

George P. Marshall, senior technical staff scientist in the Imaging Solutions Division of Lexmark International, Inc., has been involved in multiple aspects of copier and printer development. He has developed toner formulations for IBM and Lexmark printers and is a recognized figure in the area of electrophotography and related supplies disciplines. His interests include toner charge control, rheology/ fusing, print quality evaluation, and toner processing. Marshall received his PhD in Organic Chemistry from the University of Arizona (1978) and worked for IBM Corp. Office Products Division from then until 1991, at which time a divisional sale created Lexmark International, Inc. He has worked in the Toner Development Group since 1978. He served on the IS&T Board of Directors, edited IS&T's Recent Progress in Toner Tech-

nology (December 1997), and is a member of the Editorial Review Board for Particulate Science and Technology: An International Journal. He received Lexmark's highest employee honor ("Customer for Life Award") in 1996.

T02 – An Overview of Ink Jet Printing from an Ink Perspective

Sunday 8:00 am to 12:00 noon (4 hours)

Instructor: Alan Hudd, Xennia Technology Ltd.

This class provides a detailed description of the complexities of developing new chemistries for the major ink jet printing technologies and an overview of the different printhead technologies from an ink chemist's perspective. The course will concentrate on key design criteria for successful ink development and highlight the importance of good scientific understanding to ensure reliability, critical for any ink jet product. State-of-the-art characterization measurements will be presented to gain better insight into the factors influencing reliability for different applications. A review of ink technology patents will be presented based on Pivotal Resources patents service, "Directions." Examples will be used to illustrate recent major technical breakthroughs in new ink jet chemistry. The status of a range of new industrial applications will be highlighted.

Benefits: This course will enable the attendee to:

- Understand the key elements and design criteria for successful ink development
- Describe the processes influencing the development of new chemistries for ink jet printing
- Compare the ink properties required for the range of printhead technologies
- Predict reliability of ink jet products using state-of-the-art characterization measurements
- Summarize the status of the ink jet ink patent literature
- Identify recent technical breakthroughs in new chemistries

Intended Audience: This course assumes basic scientific knowledge. It provides a useful background to anyone entering the ink jet industry and those seeking an efficient update in developments of ink jet technologies.

Alan L. Hudd founded Xennia Technology, an independent contract ink jet technology house dedicated to developing new ink jet inks for the industrial and office ink jet industries, in 1996. In 1987, he joined Domino Printing Sciences and spent eight years as the Fluids Technology Manager, developing a wide range of ink jet inks for diverse applications. He is credited with a number of patents and significant innovations. He spent eight years with the Ministry of Defense and Royal Ordnance in the UK, developing new solid polymer rockets for air to air missiles. Hudd graduated with a BSc Honours in Chemistry and Physics, MSc and PhD research in Polymer Chemistry from Manchester University.

T03 – Paper-like Displays

Sunday 8:00 am to 12:00 noon (4 hours)
 Instructor: Tom Ashley, Pivotal Resources USA

This course will overview the technologies and applications of paper-like displays. The terms “paper-like displays” and “electronic paper” can be used to describe key technologies in a new generation of visual displays. These displays are based on the development and convergence of several technologies and are targeted at a wide range of applications—from microdisplays for mobile phones to very large panels for electronic billboards. Display technologies are expected to have a major impact on our future personal and business lives as they displace print and enable new products and applications that are not served by current paper-based and electronics technologies. Paper-like displays represent both a threat to traditional print technologies and an opportunity for newly developing printed electronic techniques.

Benefits: This course will enable the attendee to:

- Grasp the bistable, reflective display technologies that form the basis for paper-like displays
- Compare these technologies with other existing and emerging display technologies
- Comprehend the applications for paper-like displays and understand the merits and disadvantages of each technology
- Understand the supporting technologies that will enable paper-like displays to meet the requirements of these applications
- See how the development of printed electronics is vital to the future of paper-like displays
- Understand how such displays may impact printing and paper

Intended Audience: Engineers and scientists working in the areas of printing, paper, and consumables, as well as in the design and development of printed electronics will benefit from this class.

Tom Ashley has worked in the field of digital printing for more than 35 years. Since 1984, Ashley has been a digital printing consultant for Dataquest, BIS Strategic Decisions, CAP Ventures, and Pivotal Resources, all consulting firms specializing in digital printing and imaging. Ashley began his career with IBM, where he managed groups developing photoreceptors, inks, ribbons, and toners for IBM's first copier, laser printer, ink jet printer, and thermal transfer printer. His interest in paper-like displays dates to 1979, when he sat on an IBM committee studying the threat posed by the paperless office. Ashley holds an AB in Chemistry from Transylvania University and an MS in Organic Chemistry from Marshall University, with additional graduate work in management at the University of Kentucky.

T04 – Introduction to Electrophotography

Sunday 1:30 to 5:30 pm (4 hours)
 Instructor: Lawrence B. Schein, Consultant

Electrophotography is the primary technology

used in copiers and laser printers. In this introduction, the fundamentals of the technology will be discussed from the basic six steps to the underlying physics of the process. Discussions will include the physics of development and transfer, our current understanding of toner charging, and the challenges of color electrophotography. The architecture of some commercial applications of color electrophotography will be examined.

Benefits: This course will enable the attendee to:

- Understand the basic principles of the electrophotographic process
- Explain the more important historic advances that have occurred in electrophotography
- Compare the architecture of several mid-range copy machines
- Explain how a copier is converted into a printer
- Understand the physics of toner development, toner charging, and the transfer process
- Appreciate the technical challenges in making a color copier or printer
- Summarize commercially available color copier and printer architectures

Intended Audience: This course will be of interest to anyone working in the field of digital printing technologies.

Lawrence B. Schein received his PhD in solid state experimental physics from the University of Illinois (1970). He worked at Xerox Corporation from 1970 to 1983 and at IBM Corporation from 1983 to 1994. He is now an independent consultant. He has helped implement development systems in IBM laser printers, proposed theories of most of the known electrophotographic development systems, and contributed to our understanding of toner charging and charge transport mechanisms in photoreceptors. He is the author of “Electrophotography and Development Physics,” an IS&T Fellow, recipient of IS&T's Carlson Memorial Award (1993), a Senior Member of IEEE, and a member of the American Physical Society and the Electrostatics Society of America.

T05 – Managing R&D Projects for Value

Sunday 8:00 to 10:00 am (2 hours)
 Instructor: George Gibson, Xerox Corporation

One of the hardest challenges the technical community faces is discovering and communicating the value of new projects and technologies to the business and investment community that funds our work. Proper metrics for expressing the value of projects under consideration is essential to making sound decisions about which projects to fund and which paths to pursue. This course will familiarize the participants with the main methods for investigating and expressing the value of new technical projects and provide an overall framework that can be used to tailor your work to deliver more value to your customers and your firm.

Benefits: This course will enable the attendee to:

- Characterize the target markets for a project
- Characterize new entrants and defenders that your offering will face
- Define your offering in a manner that maximizes its value to your customer and firm
- Model and value the benefits customers will realize
- Forecast market penetration and uncertainties
- Estimate delivery costs and risks
- Calculate measures of economic return, including the use of options and portfolio management to guide a firm's investment decision making

Intended Audience: This course is intended for technical professionals who work with the business community (including individual scientists, managers, consultants and prospective entrepreneurs) to select among projects or technologies for investment.

George Gibson manager, Research and Development Portfolio in the Xerox Innovation Group of the Xerox Corporation, previously held research, development, and manufacturing management positions for Savin Corporation and AAM Graphics. Gibson holds more than 37 US patents in non-impact printing and has published ~20 papers in the field. He holds a MS in Chemistry from Binghamton University and an MBA from the William E. Simon Graduate School of Business Administration of the University of Rochester.

T06— Building a Contone to Halftone Raster Image Processor (RIP)

Monday 10:15 am to 12:15 pm (2 hours)
Instructor: Stephen Herron, consultant

This tutorial takes you through the RIP's image pipeline. The concepts and algorithms of typical raster conversion processes, useful for understanding how images are reproduced on digital printers, will be presented. The RIP process includes contone raster preparation for halftoning; methods of scan conversion of grayscale and the subtractive device color-spaces to halftone; screening methods (cluster and stochastic screening, error diffusion, pulse density modulation and hybrid); and halftone output in various bit-depths. In addition, a review of traditional PostScript halftone types, and type 9 and 100 halftones, will be discussed. The course will also include hands-on problem solving examples where participants will learn how to create halftones.

Benefits: This course will enable the attendee to:

- Understand the halftoning process including scaling, transfer functions and scan conversion
- Create halftone dictionaries and use them in the contone to halftone execution instance
- Classify halftone techniques and summarize their advantages and limitations
- Identify the performance and quality limits of halftone algorithms

Intended Audience: Engineers, scientists, and managers involved in designing and using digital printers will benefit; participants should have some familiarity with color imaging and computer systems. Students should bring a laptop computer with Microsoft Excel.

Stephen Herron was principal engineer at Toshiba where he leads half-tone research and development for EP printers. He has more than 12 years experience developing new AM and FM half-tone and imaging technologies for such companies as Isis Imaging, Software Imaging, Creo, Xerox, and Screen. He holds a masters degree in print making from Canbrook Academy of Art. Herron is a member of IS&T, a frequent presenter, and occasionally a conference A/V chair. He has presented tutorials on halftoning and the human visual system for IS&T at previous conferences.

T07 - Fabrication Materials and Processes of Ink Jet Printheads

Sunday 1:30 to 3:30 pm (2 hours)
Instructor: Hue Le, Picojet, Inc.

In recent years, enormous progress has been made in the design, fabrication, and commercialization of ink jet printing systems. This course describes the materials and processes that have been used to produce various ink jet printheads, the core component of the printing systems. Methods of forming ink jet nozzle, anti-wetting coated nozzle surface, ink channel and chamber, and various bonding methods are reviewed. Materials of thin film resistor (for thermal ink jet) and piezoelectric ceramic (for piezoelectric ink jet) are also discussed, as are issues associated with the integration of ink jet printheads into printing systems.

Benefits: This course will enable the attendee to:

- Understand the basic science and technology in manufacturing methods of various types of thermal and piezoelectric ink jet printheads
- Assess the current development in fabrication materials and processes of ink jet printheads
- Evaluate insights into the potentials and limitations of different types of printheads

Intended Audience: Scientist, engineers, product managers, and others charged with development or manufacture of ink jet printing systems will benefit from this class.

Hue Le is the CEO/president of PicoJet, Inc., which designs and fabricates fluid jetting devices for industrial printing applications. He has more than 24 years of experience in developing and commercializing ink jet printing systems. Hue Le holds 18 US patents in the field of ink jet printing technology. Prior to forming PicoJet (1997), Le held the position of director of technology development for Tektronix, Inc.'s Printing and Imaging Division. He received his BS in Chemistry from the University of Iowa (1979) and MS in Chemistry from New Mexico State University (1981).

T08 – Desktop Inkjet Products Performance Study

Sunday 3:45 to 5:45 pm (2 hours)

Instructor: Rob Beeson, Hewlett-Packard Company

This tutorial will examine products from HP, Canon, Epson, Lexmark, Ricoh, Fuji-Xerox, and Brother. Printhead performance parameters and ink/media interactions will be discussed with appropriate reverse engineering data from the HP labs. A few examples of how inkjet compares with competing technology such as dye diffusion thermal transfer and Polaroid's Opal will also be discussed. There will also be a computer modeling simulation exercise.

Benefits: This course will enable the attendee to:

- Understand printhead firing frequency, drop volume, velocity, and drop shape tradeoffs from the principal desktop inkjet printer manufacturers
- Examine key differences in piezo and thermal inkjet printhead performance characteristics
- Predict future directions in desktop inkjet products using patent literature

Intended Audience: This course is intended for those somewhat familiar with inkjet printing technology who want a better understanding of the differences of printhead output parameters from the popular manufacturers.

Rob Beeson is a senior member of the technical staff in the Inkjet Technology Platforms Unit of Hewlett-Packard. He has held several management and engineering positions in thermal inkjet technology since 1985, and is currently the R&D Competitive Intelligence Team Leader. He holds 12 inkjet patents. He has a BS and MS in Mechanical Engineering from Colorado State University and has worked with several divisions in HP since 1966.

T09 – Liquid Toner Printing: Technology and Applications

Sunday 1:30 to 5:30 pm (4 hours)

Instructor: George Gibson, Xerox Corporation

Liquid toner technologies have long been held as providing versatile methods for imaging in a variety of applications. Known for high image quality, especially high-quality color, liquid toners are used less widely today than either ink jet or dry xerographic techniques. They are, however, beginning to show up in display and manufacturing applications, as well as in document printing. This course will cover the variety of liquid toner processes that are and have been used including analysis of the relative strengths and limitations of each and the major applications areas in which these techniques are used. Included will be an analysis of improvements in liquid toner systems found in recent products, technical literature, and patents. The goal of the course is to take one through the history up to the state-of-the-art in liquid toner technology.

Benefits: This course will enable the attendee to:

- Recognize the fundamentals of five generations of liquid toner device architectures
- Appreciate the composition and preparation methods for liquid toners
- Describe how the components of the toner and characteristics of the process drive print properties
- Know the major market applications where liquid toners are used today
- Recap recent innovations in liquid toner technology

Intended Audience: The course is intended for technical professionals who want to become more knowledgeable about liquid toners, their processes, properties, and applications.

George Gibson's biographical sketch appears in the description for Tutorial T05.

T10-Introduction to Organic Electronic Materials and Devices

Sunday 1:30 to 5:30 pm (4 hours)

Instructors: Zoran D. Popovic and Tim Bender, Xerox Research Centre of Canada

The research, development, and technological applications of organic electronic materials and devices is an area of intense current interest that entails applications in many fields including xerography (photoconductors), displays (organic light emitting devices, OLEDs), sensors, and electronic circuitry (organic thin film transistors, TFTs). This tutorial will begin with a survey of these current areas of application, showing where organic materials may offer advantages over traditional inorganic materials. The key classes of organic materials involved: photoconductors, semiconductors, transport molecules (hole and electron), light emitter materials, and conductors will then be discussed from the standpoint of molecular design, synthesis, purification, and characterization. This tutorial aims to compare and contrast material requirements for the different applications. Finally an overview of the characterization methods of important electronic material parameters and evaluation methods of currently used devices will be given together with some device design principles. The main emphasis will be small molecule systems although, where relevant, polymeric systems will also be discussed.

Benefits: This course will enable the attendee to:

- Understand technological applications where organic electronic materials are, or may become, important
- Develop criteria for the design, synthesis, purification, and broad-scale characterization of organic electronic materials
- Describe some of the specialized techniques used to characterize these materials both as pure molecules and in devices
- Explain basic device design concepts

Intended Audience: Although based primarily on chemistry and physics, this course will be of interest to a wide audience of scientists, engineers, project managers, and others interested in the design, synthesis, and applications of organic electronic materials. As an introductory course, the subject matter will not be dealt with in great detail. Rather the audience will be introduced to the key areas of scientific expertise required to become knowledgeable in this area. References to more detailed information will be provided.

Zoran D. Popovic has a BS in electrical engineering from University of Belgrade and a PhD in materials science from McMaster University (Canada). He has worked at the Xerox Research Centre of Canada for more than 30 years, where he is currently a research fellow. His major interest has been in organic photoreceptors and, more recently, in organic electroluminescent devices. Popovic is internationally renowned in both fields; he has published more than 120 scientific papers and holds 50 US patents.

Tim Bender received both his BS and PhD in Chemistry from Carleton University (Ottawa, Canada). He is currently a member of the research staff at Xerox Research Centre of Canada where he has been a member of the Imaging Materials Design and Synthesis Group for the past four years. He was appointed to this position after a one year NSERC Post-doctoral Fellowship. Bender has authored 15 scientific papers in a number of fields including imaging materials and fundamental polymer chemistry and materials science and holds seven US patents in the area of imaging materials. In 2004 he was appointed an adjunct professor of chemistry at McMaster University (Canada).

T11 – Direct-Write Technologies for Rapid Prototyping Applications: Sensors, Electronics, and Power Sources

Monday 8:00 am to 5:30 pm (8 hours)
Instructor: Douglas B. Chrisey,
US Naval Research Laboratory

Direct Writing describes any technique or process capable of depositing, dispensing, or processing (including removal of) different types of materials over various surfaces following a preset computer-generated pattern or layout (see “Direct-Write Technologies for Rapid Prototyping Applications: Sensors, Electronics, and Integrated Power Sources,” A. Pique and D. B. Chrisey, Academic Press, 2002). Direct Writing allows designers and manufacturers to bypass the traditional staged assembly process and/or part specific tooling and “grow prototypes” that will operate as a final product. There is a strong need in the electronics industry to reduce product design and development times, and to adaptively produce small lots at a competitive cost. Conventional thick film techniques like screen printing and low resolution lithography often require several iterations of the development cycle (circuit design – mask fabrication – prototype manu-

facture – testing and evaluation – iterate design – repeat) before a new electronic device or subsystem can go to market. The materials, processes, and systems for Direct Write are at various stages of maturity with some off-the-shelf fully integrated systems available, but in many cases further development will be required before implementation in a production line. This course will give an overview of Direct Write technology with examples of its benefits and barriers and especially how it is affecting the world of electronics, sensors, and power sources.

The course will begin with introductory materials in the morning and move to more advanced topics as the day progresses.

Benefits: This course will enable the attendee to:

- Understand the attributes of different direct write techniques
- Compare direct write materials and substrates
- Outline the technological issues and challenges for direct writing
- Understand the market issues in electronics direct writing
- Examine real examples of direct writing electronics, sensors, power sources, and biomaterials

Intended Audience: Engineers and scientists working in or interested in entering the areas of Direct-Writing conformal electronics, sensors, and power sources will benefit from this tutorial.

Douglas B. Chrisey received a BS (Honors) from SUNY Binghamton (1983) and a PhD in Engineering Physics from the University of Virginia (1987). He joined the US Naval Research Laboratory as a staff member and became head of the Plasma Processing Section. His past research has focused on the novel laser fabrication of thin films and coatings of advanced electronic, sensor, biomaterials, and, more recently, novel approaches, materials, and devices fabricated by Direct Write fabrication. He has 14 patents, edited or co-edited 10 books, written eight chapters and 385 publications, and has nearly 4,000 citations.

T12 – High Quality Displays for Softproofing

Monday 8:00 am to 12:00 noon (4 hours)
Instructor: Gabriel Marcu, Apple Computer

This tutorial discusses the most advanced display technologies and their impact in the success of softproofing. Factors such as display technology, resolution, color gamut, viewing angle, gain function, luminance level, glare, and color model accuracy are discussed. The importance of color management (including characterization and calibration) for accurate color reproduction is covered. Practical examples of softproofing are illustrated during the course and the influence of viewing conditions and adaptation on evaluation of displayed color is highlighted.

Benefits: This course will enable the attendee to:

- Identify the key elements in achieving a high color quality in electronic displays
- Understand and compare display technologies in terms of color reproduction and color performance
- Recognize the effect of chromaticities, tone correction (“gamma”), and white point in color reproduction on electronic displays
- Identify the role of the CMM and its advantages/limitations in achieving high-quality color reproduction
- Recognize the role of characterization and calibration for accurate color reproduction
- Understand the role of gamut mapping on color quality for displays
- Understand the role of adaptation in judgment of color matching between displays and prints
- Understand the importance of the viewing conditions for color quality on displays

Intended Audience: This tutorial is intended for engineers, scientists, and managers confronting color quality issues on electronic displays. Participants should have familiarity with color imaging and computer systems.

Gabriel Marcu is senior scientist in the ColorSync Group at Apple Computer. His achievements are in color reproduction (device characterization and calibration, halftoning, gamut mapping, ICC profiling). In the last eight years, Marcu has taught seminars and short courses on color imaging topics for various IS&T, SID, and SPIE conferences. Since 1998 he has been co-chair of the IS&T/SPIE Electronic Imaging Symposium Conference on Color Hard Copy and Applications, and he is general co-chair of the 2006 Electronic Imaging Symposium.

T13 – Organic Photoreceptors for Digital Electrophotographic Printers

Monday 8:00 to 10:00 am (2 hours)
 Instructor: David Weiss, NexPress Digital LLC

This course will detail the architecture, chemistry, manufacturing, testing, and functional requirements of organic photoreceptors used in today’s electrophotographic printers. Discussions will include current trends in organic photoreceptor technology and the unique requirements of digital printing that must be satisfied.

Benefits: This course will enable the attendee to:

- Understand how organic photoreceptors function in an electrophotographic printer
- Discuss the interplay between architecture and electrophotographic function
- Explain the relationships between chemical make up and electronic functions of the various layers in an organic photoreceptor
- Describe the technologies involved in the manufacturing of organic photoreceptors
- Assess how organic photoreceptors are studied and characterized

Intended Audience: Those with an interest in understanding organic photoreceptors and how they function in modern, digital, electrophotographic printers will benefit from this course. A general background in chemistry and physics is helpful, but not essential.

David S. Weiss, scientist fellow at NexPress Digital LLC, received his PhD in chemistry from Columbia University (1969). His work focuses on electrophotographic technologies with emphasis on organic photoreceptors. He holds 15 US patents and is author on more than 70 publications. He is co-author of Organic Photoreceptors for Imaging Systems (Marcel Dekker, Inc., 1993), Organic Photoreceptors for Xerography (Marcel Dekker, Inc., 1998) and he is co-editor of the Handbook of Imaging Materials, Second Edition (Marcel Dekker, Inc., 2002). He has been is an associate editor of the Journal of Imaging Science and Technology since 1988; and served as General Chair of NIP17 and in many other NIP committee assignments. In 1999 he received the Carlson Memorial Award and in 2004 he was named an IS&T Senior Member.

T14 – Physics of Organic Electrophotographic Photoreceptors

Monday 10:15 am to 12:15 pm (2 hours)
 Instructor: Andrew Melnyk, Consultant

This course will provide a detailed description of the architecture, physics, operation, testing, system interactions, and failure modes of organic photoreceptors used in today’s electrophotographic printers. Discussions will include current trends in organic photoreceptor technology and the unique requirements of digital printing that must be satisfied. To obtain a complete understanding of the interplay between the architecture, construction, physics, chemistry, and performance of organic photoreceptors it is highly recommended that this tutorial be taken in conjunction with the T13-Organic Photoreceptors for Digital Electrophotographic Printers, in which the detailed chemistry, material design, and manufacturing of organic photoreceptors will be discussed.

Benefits: This course will enable the attendee to:

- Understand the design and operation of organic photoreceptors
- Explain the basics of how organic photoreceptors function in an electrophotographic printer
- Identify photoreceptor failure modes and diagnose problems
- Describe how organic photoreceptors are studied and characterized
- Appreciate photoreceptor interaction issues in the design of an electrophotographic system

Intended Audience: Those interested in understanding organic photoreceptors and how they function in modern digital electrophotographic printers will benefit from this class. It is also useful to engineers designing electrophoto-

graphic printers and anyone engaged in the development, manufacturing, and testing of photoreceptors. A general background in chemistry and physics is helpful, but not essential.

Andrew R. Melnyk (retired 2002) was principal scientist at Xerox Corporation in Webster, NY. He received his PhD in theoretical solid state physics from Michigan State University (1967). Following a NRC postdoctoral fellowship at the NBS Labs in Boulder, Colo., he joined Xerox in 1969, where he pursued research in photoconductors and imaging technologies. His primary research interests are in the areas of electro-optical properties and electronic processes of organic materials, their measurement and modeling, and the design of electrographic printers. He holds several dozen patents and has published journal articles and book chapters on photoconductors; has taught short courses on photoconductors at Xerox and NIP conferences. Since its inception, Melnyk has been an active participant in NIP, serving in various capacities, ranging from Session to General Chair (NIP12).

T15 – Technologies and Opportunities for Photographic Quality Printing

Monday 1:30 to 5:30 pm (4 hours)

Instructor: James C. Owens, Torrey Pines Research

The technologies available to photography, printing, and display have developed dramatically in the last few years leading to startling workflow efficiency improvements in some existing businesses, but also opening many opportunities for new businesses and applications. Our challenge in optics, electronics, and software is to build devices and systems that match or exceed the visual quality and system robustness of traditional photography while improving on its flexibility and range of application. In this course, we discuss new opportunities for high-quality imaging, choosing the most appropriate technical approach, and selecting the best printing method.

Benefits: This course will enable the attendee to:

- Identify the major commercial and scientific applications of photographic-quality color printing
- Describe the most important attributes of image quality and customer preference
- Select appropriate image capture devices
- Choose file formats and color management devices and software
- Explain and compare the principles, advantages, and disadvantages of the major color printing technologies
- Recognize the appearance and causes of the most common image artifacts produced by digital systems and develop designs that avoid them
- Explain and give examples of workflow simplification
- Select and apply the most appropriate imaging technology for a given application

Intended Audience: This course is geared to-

ward engineers, scientists, product planners, and end users needing a broad understanding of digital imaging technology along with judgment and perspective in order to choose and adapt the appropriate process for any given application.

James C. Owens is a physicist with 30 years experience in the development of many types of imaging systems at the Research Laboratories of Eastman Kodak Company, where he received the C. E. K. Mees Award for his work on hardware and media for infrared laser scan printing. Owens is currently the senior fellow of Torrey Pines Research. He is a Fellow, a past president, a past visiting lecturer, and currently the web tutorial editor of IS&T; the chair-elect of the New York State Section of APS; the past president and currently a councilor of the Rochester Section of OSA; and a member of IEEE.

T16 – Papermaking, Coating Fundamentals, and Media for Digital Printing

Monday 1:30 to 5:30 pm (4 hours)

Instructor: Sen Yang, International Paper

This tutorial includes an introduction to papermaking and coating technologies and a discussion on media requirements for digital printing with an emphasis on electrophotographic (EP) and inkjet printing applications. Paper attributes that are important for color EP and inkjet printing will be reviewed and discussed.

Benefits: This course will enable the attendee to:

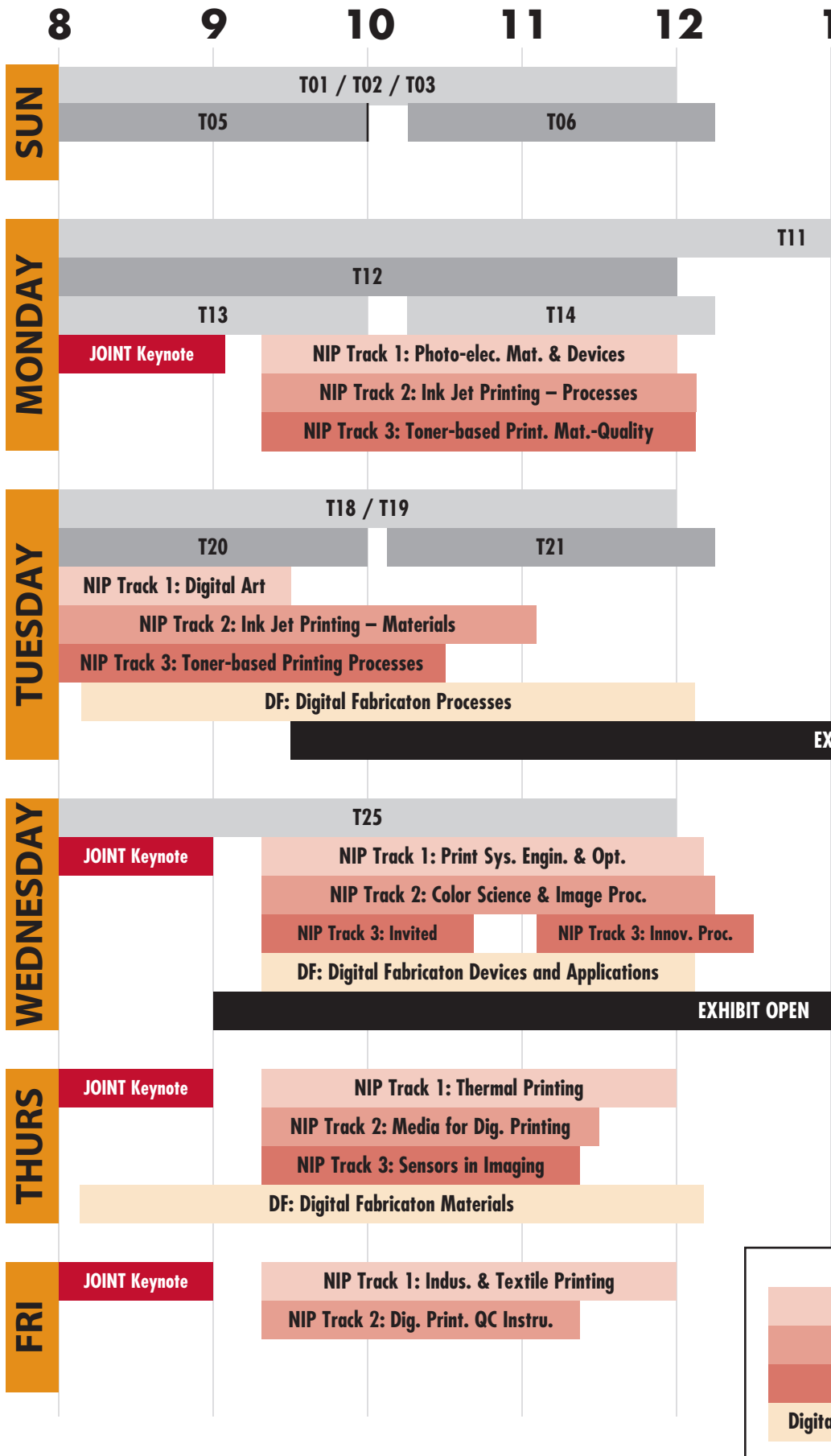
- Describe the basics of papermaking and paper coating processes
- Understand paper property and testing methods
- Comprehend key media properties for achieving good color printing performance for EP and inkjet printing

Intended Audience: This class is directed toward anyone seeking an introduction to papermaking and paper coating fundamentals and who wants a better understanding of the relationship of media properties and performance for EP and inkjet printing. No working knowledge of papermaking or coating techniques will be presumed or required.

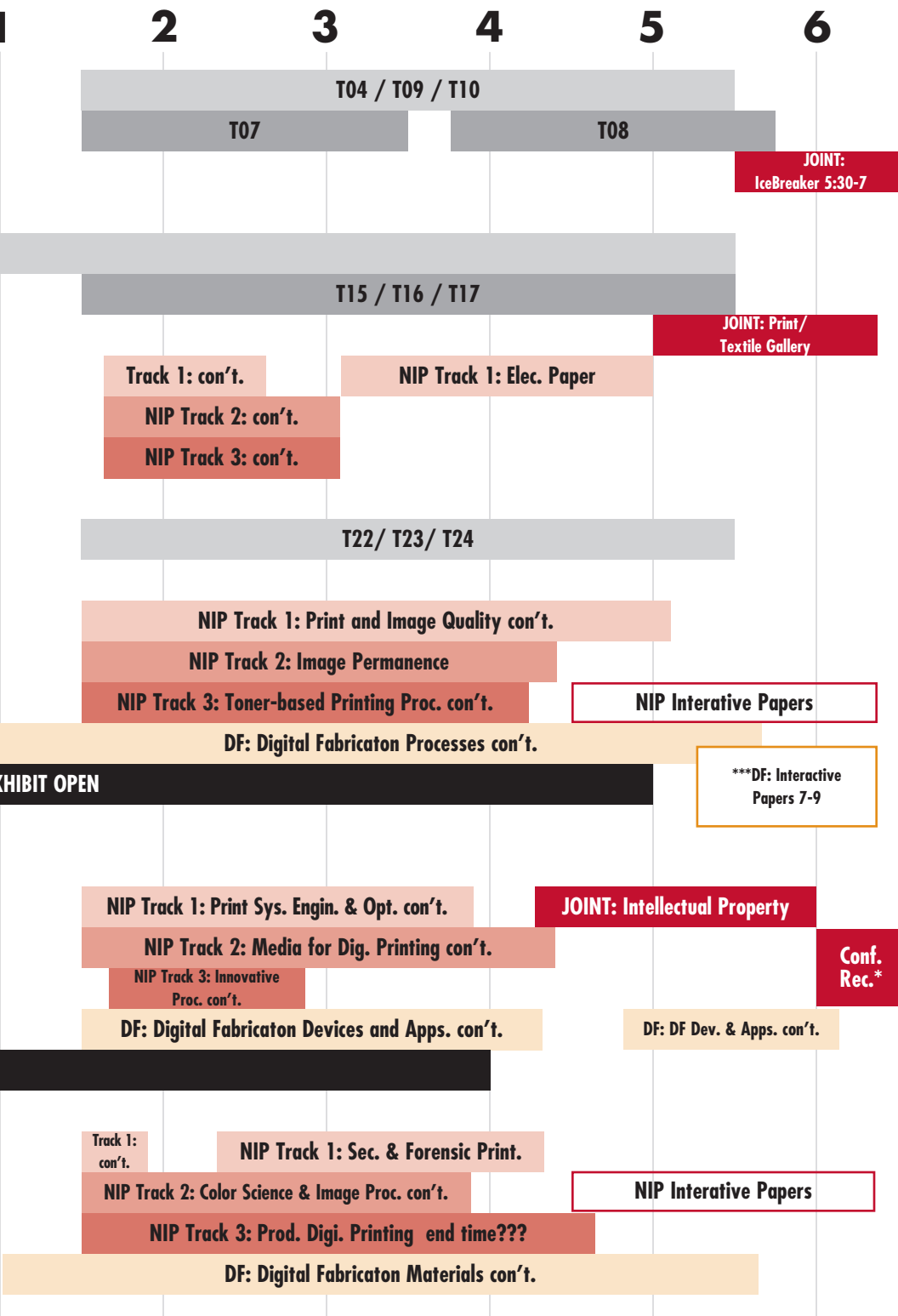
Sen Yang is manager of Surface Science and Digital Printing in the corporate research center of the International Paper Company. He received his PhD in polymer science from Brown University. Since 1990, he has worked in the field of specialty paper and film coatings for digital imaging applications. Prior to joining International Paper, Yang worked for Océ-Arkwright and Champion International Corporation where he led and contributed to a number of successful specialty paper and coated film products both for private label and OEM businesses. He has several patents in the area of coated inkjet paper and specialty films.

continued on page 18

NIP21/Digital Fabrication 2005 Week At-a-Glance



Digital Fabrication



LEGEND

- NIP Track 3 held at Hyatt Regency
- NIP Track 3 held at Hyatt Regency
- NIP Track 3 held at Hyatt Regency
- Digital Fabricaton held at Sheraton Inner Harbor

- Joint Sessions/Receptions held at Hyatt Regency
- Exhibit held at Hyatt Regency
- Tutorials held at Hyatt Regency

Icebreaker: Monday 5:30-7 pm
 * Joint Conference Reception: Wednesday 6-8 pm

T17 – Image Quality: Perception and Quantification

Monday 1:30 to 5:30 pm (4 hours)

Instructor: Eric K. Zeise, NexPress Solutions, Inc.

A meaningful description of image quality requires an accurate link between the measurement of an attribute and its perceived quality. Measurement without a link to perception can lead to meaningless specsmanship. Perception without objective measurement can degenerate to opinion. In this course, we examine the characteristics and limitations of human visual perception and the models of perception used to describe the appearance of objects. From this perspective, we identify important attributes of image quality and investigate measurement techniques used to quantify these attributes. We examine the scope, utility, and limitations of standards that permit comparison of non-impact printing device image quality. We will work through short examples of psychometric scaling methods that create the required relationship between instrumental measurement and perceived quality, allowing a meaningful, quantitative measurement of perceived image quality.

Benefits: This course will enable the attendee to:

- Utilize psychometric scaling methods to provide meaningful, quantitative measurement of perceived image quality
- Understand the limitations of perception to avoid over-specification; the applicability of important image-quality measurement techniques; and the utility of standards for comparison of device image quality
- Examine the scope, utility, and limitations of standards that permit comparison of non-impact printing device image quality

Intended Audience: This course is directed towards anyone seeking to understand the quantitative measurement of perceived image quality. No prior experience is necessary.

Eric K. Zeise is a research associate and group leader for image quality evaluation at NexPress Solutions Inc., a Kodak Company. He has been involved in many aspects of color systems modeling, printing system architecture, and perceptual image quality evaluation since joining the research laboratories of Eastman Kodak Co. in 1981. Zeise is chair of the ANSI/ISO SC28 and INCITS W1.1 standards project (ISO 19751) for perceptually linked determination of image quality for printing systems. He was an initial staff member of NexPress LLC when it was formed in 1998 as a joint venture between Eastman Kodak Co. and Heidelberg Druckmaschinen AG. He received a PhD in low-temperature physics from Cornell University (1981).

T18 – High Quality Color Printing

Tuesday 8:00 am to 12:00 noon (4 hours)

Instructor: Gabriel Marcu, Apple Computer

This tutorial discusses and illustrates the most important quality factors in color printing.

Elements such as reproduction technology, colorant/ media interaction, geometric resolution, halftoning, color separation (including UCR/GCR), TRC corrections, and gamut mapping will be examined for their influence on print quality. The importance of color management (including characterization and calibration) for high-quality color reproduction is discussed, as is the influence of chromatic adaptation and the viewing conditions on evaluation of print quality. The role of measurement and interpretation of data (including gamut comparison) for color-quality evaluation will be demonstrated. The importance of test and reference images is illustrated with examples.

Benefits: This course will enable the attendee to:

- Identify the key elements and technology limitations in achieving a high color quality in printing
- Compare the color gamut on different media and understand the role of ink/media interaction
- Understand the role of tone reproduction, halftoning, color separation, and gamut mapping on color quality
- Understand the difference between Gray Component Replacement and Under Color Removal techniques and their contributions in high-quality color reproduction
- Understand the influence of halftoning in achieving a high-quality color reproduction and the practical limitations due to dot gain
- Identify the advantages and limitations of CMM in achieving high-quality color reproduction in desktop printing and demonstrate the role of characterization and calibration for accurate color reproduction

Intended Audience: The tutorial is intended for engineers, scientists, and managers confronting color quality issues in color reproduction. Participants should have familiarity with color imaging and computer systems.

Gabriel Marcu's biographical sketch appears in the description for Tutorial T11.

T19 – Image Permanence: Understanding, Measuring, and Predicting Print Life

Tuesday 8:00 am to 12:00 noon (4 hours)

Instructor, Jon A Kapecki, Imaging Consultant

All images change with time, and modern imaging systems are no different. Rather, they bring with them new challenges for understanding and predicting those changes. This tutorial will take a data-driven approach to the four major factors that influence the permanence of hard copy images and how those factors interact. Because people, not machines, perceive images, the course will examine how people use their images in the real world and why human factors and psychophysics are important in understanding how people perceive change. It will also look at how we measure change and try to

predict the future state of images, along with the pitfalls that are inevitable in this endeavor, and why a holistic approach to image permanence is mandatory. Real world systems, how they have improved over the years, how hidden factors can result in unexpected results, and why state-of-the-art imaging systems require new approaches to deal with image permanence issues will be discussed, as will standards, their importance, and their pitfalls, and how we use measurements and standards to communicate to the customer what people really want to know. The course will conclude with a brief look to the future: new technologies for image stability and new uses and expectations for imaging systems. To help attendees reach their own conclusions, data and reference materials needed to apply the concepts taught in the class to a particular environment will be distributed.

Benefits: This course will enable the attendee to:

- Describe how images are used in real world environments
- Identify the causes of image degradation and how they interact
- Know the four questions you should always ask about image preservation
- Understand how we measure both objective and subjective change in images
- Appreciate the pitfalls involved in predicting image permanence
- Recognize the value and the limitations of image permanence standards
- Understand the arguments for a holistic approach to image permanence

Intended Audience: This course will be of value to anyone who creates, uses, sells, or preserves photographic-quality images and who wants to understand how these images change over time under the influence of environmental factors. Examples will be drawn from a variety of imaging technologies to understand both their differences and common attributes.

Jon Kapecki is an imaging consultant who was a senior researcher for more than 30 years at Eastman Kodak Company where he studied image formation and degradation processes and new photofinishing technologies. He holds a PhD from the University of Illinois and has taught courses at Kodak, the University of Rochester, and state universities. He has authored several review articles and encyclopedia entries on imaging systems and is a member of an ISO task group on image permanence standards.

T20 – Revised Kubelka-Munk Theory and its Applications

Tuesday 8:00 to 10:00 am (2 hours)
Instructor: Li Yang, Karlstad University, Sweden

The revised Kubelka-Munk (K-M) theory is a newly developed theoretical model that is more general when compared to the original and applies to various media systems of light absorption and scattering, for instance, ink, paper,

print, dyed-sheet, textile, etc. This course will present a thorough analysis of light propagation processes in turbid media followed by detailed descriptions on the fundamentals of the theoretical revision, which enables the (revised) theory to be applicable to any turbid media system. The theory is further illustrated by application to different media systems consisting of both weak and strong light absorption materials.

Benefits: This course will enable the attendee to:

- Understand light absorption and scattering in turbid media
- Define the background (physical considerations and assumptions) of the original (K-M) theory
- Explain how the theoretical model is applied to determine the intrinsic (optical) properties of materials
- Determine how to predict the optical or chromatic presentation of a composite (a mixture of optically different materials) from the intrinsic properties of its material components
- Comprehend the fundamentals of the revised theory

Intended Audience: The course is designed for engineers and scientists working in areas concerning the optical properties or color of materials and composites (e.g., ink, paper, textiles, printing, etc.).

Li Yang is a senior lecturer in the Department of Graphic Technology, Karlstad University, Sweden. His research activities cover broad areas, including paper optics, prepress, and ink-paper and light-paper interaction. He is the initiator and the main contributor to the work on revising the Kubelka-Munk theory. He has more than 40 journal publications and many conference reports.

T21 – Electrostatic Toner Transfer

Tuesday 10:15 am to 12:15 pm (2 hours)
Instructor: Thomas N. Tombs, NexPress Solutions, Inc.

An important and potentially quality-limiting step in all electrophotographic machines is the transfer of toner from the photoconductor to paper. A significant degree of complexity is inherent in toner transfer resulting from the many interactions that exist with essentially every other subsystem in the electrophotographic process. In this course, explanations of the important mechanisms of dry-toner transfer provide a foundation for understanding the many interactions and noise factors. Throughout the course practical working knowledge of transfer technologies is conveyed.

Benefits: This course will enable the attendee to:

- Comprehend the operation of various electrostatic transfer technologies
- Explain the important mechanisms of toner transfer

- Identify noise factors and material properties that affect toner transfer
- Describe and explain causes of transfer-related image quality degradation
- List and explain the interactions between the transfer subsystem and other subsystems

Intended Audience: This course is intended for engineers, scientists, and managers involved or interested in electrophotographic research, development, or commercialization. Familiarity with the electrophotographic process and college-level physics are recommended prerequisites.

Thomas N. Tombs, chief engineer directing the research and development of electrophotographic technologies at NexPress Solutions, Inc., received a PhD in electrical engineering from the University of Rochester specializing in the fields of electrostatics and particle electromechanics. His involvement with electrophotography began at Eastman Kodak Company in 1992. When NexPress was formed in 1998, he joined to implement the transfer technology he developed in the research labs of Kodak and continued R&D on a range of electrophotographic subsystems and materials. Tombs has more than 40 US patents and has published articles on particle electrostatics and electrostatic toner transfer.

T22 – Electrostatics and Particle Adhesion in Electrophotography

Tuesday 1:30 to 5:30 pm (4 hours)
Instructor: Dan A. Hays, Xerox Corporation

Electrophotography is widely used in digital copiers and printers to produce high-quality documents for office and production markets. Over the years, continual advances in the technology have enabled high-speed printing and excellent image quality for both mono- and full-color printing. This tutorial provides a foundation for understanding various electrostatic phenomena that are exploited in the electrophotographic process and serves as an introduction to electrostatics topics covered in other related tutorials on electrophotography including “Introduction to Electrophotography,” “Introduction to Toner Technology,” “Electrostatic Toner Transfer,” “Physics of Electrophotographic Development,” “Charging Systems and Dependent Processes in Electrophotography,” and “External Additives for Xerographic Toners.”

Benefits: This course will enable the attendee to:

- Understand basic concepts regarding electrostatic forces, electric fields, electrostatic potential, and energy
- Comprehend the role of electrostatics in the electrophotographic process
- Describe different methods for charging or neutralizing an insulative layer
- Identify different methods for charging powder (toner)
- Describe techniques for measuring the charge on an insulative layer and powder
- Appreciate how the maximum electric field

for air breakdown depends on the air gap and particle size

- Describe the importance of charged particle adhesion in electrophotography
- Explain model descriptions of charged particle adhesion due to Van der Waals and electrostatics forces for both uniformly and nonuniformly charged particles
- Understand adhesion and electric field detachment measurement methods and results for triboelectric and ion charged particles

Intended Audience: This tutorial is intended for technicians, engineers, scientists, and managers involved in electrophotographic research and engineering. Familiarity with college-level physics is a recommended prerequisite.

Dan A. Hays is a senior fellow at Xerox Corporation in the Wilson Center for Research and Technology. His research and technology contributions in the field of electrophotography have spanned the areas of triboelectricity, charged particle adhesion, and xerographic development systems. He received the Xerox President’s Award in 1980 and 1997, and IS&T’s Chester Carlson Award in 1991. He was appointed an IS&T Fellows in 1996 and received the American Institute of Physics 1997-98 Prize for Industrial Applications of Physics. In 1999, he became a Fellow of the American Physical Society and received the Gutenberg Prize from the Society for Information Display. He has been a leader in IS&T’s Digital Printing Technologies Conferences and the NIP Technical Council. Hays has published 55 scientific papers and holds 58 US Patents. Prior to joining Xerox in 1968, He received a BS from Iowa State University and a PhD in physics from Rutgers University.

T23 – Evaluating Ink Jet Technology

Tuesday 1:30 to 5:30 pm (4 hours)
Instructor: Ross N. Mills,
imaging Technology international (iTi) Corporation

This course will cover the criteria for evaluating and selecting ink jet and the correct type of ink jet technology for digital materials deposition in printing, scientific, and manufacturing applications. In addition to an advanced introduction to the different types of ink jet, the fundamental advantages and disadvantages of each type will be discussed. Topics such as the influence of throughput parameters, morphology, ink and substrate physical properties, maintenance, and reliability on printhead selection for these applications will be presented. Business and technical issues such as make or buy, do-it-yourself or hire-it-done, availability and cost of printheads, and time-cost tradeoffs to complete the application will be covered.

Benefits: This course will enable the attendee to:

- Understand how to balance throughput parameters, materials physical properties, and operating environment with printhead selection for a given application
- Select measurement and development tools

for process and performance analysis on ink jet printheads

- Understand the basics of how to integrate a printhead technology into an application
- Assess ink jet technologies and applications for technical and business uses in program and product planning

Intended Audience: This course is for those who have a basic understanding of ink jet technology and who wish to expand their knowledge base in both the technology and its applications.

Ross N. Mills, currently chairman of the board and the chief technical officer of imaging Technology international (iTi) Corp., received his PhD and MS in Engineering Science from the University of California at Berkeley and his BS in Aerospace Engineering from the University of Texas at Austin. Since 1978, he has worked as a research, development, and manufacturing engineer in both staff and management capacities in the areas of piezoelectric and thermal ink jet printers and electrophotographic printers for IBM, Lexmark International, and Topaz Technologies, as well as iTi. In 1992, he founded iTi Corp. in Boulder, Colo., as an ink jet consulting and development firm, and as an integration facility for advanced applications in ink jet and imaging technology. Mills has 12 patents in this field and he is the inventor of iTi's proprietary ESIJET™ technology.

T24 – Chemical Toners

Tuesday 1:30 to 5:30 pm (4 hours)

Instructor: Grazyna Kmiecik-Lawrynowicz,
Xerox Corporation

This course on chemical toners will enable participants to understand the nature of chemical toner technology in comparison with conventional grinding processes for making xerographic toners. It will cover different chemical processes and raw materials used for preparation of chemical toners, as well as the history of chemical toner development. The course will discuss current products with chemically prepared toners that are on the market and will point out the advantages and disadvantages of chemical toner compared with pulverized toners in their performance and interaction with xerographic systems.

Benefits: This course will enable the attendee to:

- Understand the nature of the chemical toner process in comparison with the conventional grinding process
- Distinguish chemically prepared toners from pulverized toners
- Make judgments and assessments as to the best toner technology for a given xerographic application based on the advantages and disadvantages of each
- Understand the current scenario of chemically prepared toner on the market and its potential for future applications

Intended Audience: This class will offer an in-

roduction to chemically produced toners and is directed toward anyone seeking an understanding of the nature of chemical toners and its potential in xerographic application. Some knowledge of xerography and chemistry is helpful, but is not essential.

Grazyna Kmiecik-Lawrynowicz is a principal scientist in Material and Process Technology in the Supplies Delivery Unit of Xerox, where she leads chemical toner technology and polymer carrier coating design activities. She received her MSc and Eng Degree in Chemistry & Chemical Engineering from Warsaw Technical University in Poland, and her PhD in Chemistry from Rutgers. After postdoctoral work at the University of Toronto, she joined The Xerox Research Center of Canada (1988) where she worked on projects related to chemical toners. In 1992, she pioneered work on Emulsion Aggregation (EA) toner at Xerox for future color xerographic applications. In 1996, she transferred with EA toner technology, to Supplies Development and Manufacturing. Kmiecik-Lawrynowicz has 88 publications and patents, including 69 US patents. She is a recipient of three Eagle Awards for the highest number of patents at Xerox (1994, 1997, and 1998), is an IS&T Fellow, a member of the American Chemical Society, and has been an invited speaker at numerous conferences.

T25 – Digital Technology and the Security of Documents

Wednesday 8:00 am to 12:00 noon (4 hours)

Instructor: Annette B. Jaffe, Consultant

This tutorial will cover the field of security devices ranging from optical security features to classic features such as watermarks and how they protect documents. The course also will explore how digital technology has changed the problems and solutions for documents. Recent developments in color print technologies will be reviewed.

Benefits: This course will enable the attendee to:

- Learn the basics of security devices and how digital technologies such as ink jet and electrophotography interact with security and security features
- Explore the advantages and disadvantages of security devices, as well as the new inks, toners, etc. being used for security
- Speculate on the future

Intended Audience: This tutorial is intended for scientists and engineers who are interested in security and implications for digital printing.

Annette Jaffe received a BA in Chemistry and a PhD in Physical Chemistry. For more than 25 years she has worked on printing technologies at IBM Research, Apple Computer, and Texas Instruments. She is currently a consultant in digital color imaging, security printing and digital anti-counterfeiting.

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How to Read the Schedules

Trying to figure out when a particular presentation will occur?

You can do so more easily by knowing how much time is allotted for each type of presentation within a session.

Keynotes: 60 minutes

Invited: 40 minutes

Focal: 30 minutes

Oral: 20 minutes

Interactive (paper preview): 5 minutes

Coffee breaks are also scheduled to occur mid-morning and mid-afternoon.

NIP Program-at-a-Glance

Join your colleagues in Baltimore, Maryland, for NIP21. This conference has been providing a forum for the discussion of advances in all aspects in non-impact and digital printing technologies and related technologies for more than two decades. Highlights of the conference include:

- A Tutorial Program, which takes place Sunday through Wednesday offering 25 short courses on a wide variety of subjects. Detailed descriptions of the tutorials begin on page 9.
- Keynote addresses given by international industry leaders and scientific experts from Xerox Supplies, Osaka University, MIT and the Paul-Scherer Institute.
- Co-location with IS&T's first conference on Digital Fabrication technologies, which brings together traditional non-impact printing technologies with new printing and manufacturing applications, patterning, and printing of two- and three-dimensional structures at physical scales ranging from nanometers to meters. NIP and Digital Fabrication 2005 participants can listen to talks in both conferences.
- A three track Technical Program that features more than 180 papers in 20 sessions, including four special topic sessions—plus attendees of NIP 21 can take advantage of the 60 papers scheduled for Digital Fabrication 2005.
- Four Special Topics sessions that offer attendees the opportunity to listen to invited presentations by experts in the areas of Digital Art, Production Digital Printing, Sensors in Imaging, and Nanotechnology in Imaging Science and Instrumentation.
- A Print Gallery that will open from Monday afternoon through the end of the day on Wednesday and will include a Textile and Digital Art Exhibit as part of two technical sessions.
- Presentation of the IS&T Chester F. Carlson Award to Inan Chen for his contributions to the science and technology of electrophotography on Monday morning after the keynote.
- Interactive Papers that are incorporated into the technical sessions as Interactive Oral Previews. These papers will then be on display during one of two Interactive Paper Sessions (see page 27). These sessions provide an opportunity for one-on-one interaction with the authors during which light refreshment are served.
- The NIP 21/Digital Fabrication 2005 Exhibition, open on Tuesday and Wednesday, that will showcase a wide range of products, applications, and services related to printing and imaging.
- A Wednesday afternoon, panel discussion on Intellectual Property that will feature international experts talking on topics ranging from valuation, protection and litigation, and trademarks to brand protection and patent law.
- A Social Program that includes an Ice Breaker Reception on Sunday evening and the Conference Reception on Wednesday evening.

If you work in the field of digital printing or related technologies, NIP 21 is the conference to attend!

Special Events

Special Topics Sessions

Digital Art

Digital Artists have special requirements of digital printing, particularly in the areas of color science, permanence, and materials. This session will focus on their needs.

Sensors in Imaging

Developments in sensors are fundamental to digital and medical imaging. These sessions will address the most recent advances in this technology.

Production Digital Printing

This session will shed some light on the technology behind new digital printing equipment and systems.

Nanotechnology in Imaging Science and Instrumentation

This session addresses instrumentation which helps one understand the properties of very small structures and particles, and of surfaces that may lead to unexpected advances in material design and fabrication.

NIP21 Technical Program

MONDAY, SEPTEMBER 19, 2005

TRACK 1

9:20 am to 12:00 noon

Photo-electronic Materials and Devices

Session Chairs: Huoyjen Yuh, Xerox Corporation; Shinji Aramaki, Mitsubishi Chemicals Company; and Reinhard Baumann, MAN Roland

New Electron Transport Materials with High-Drift Mobility Comparable to Hole-Transporting Materials (Oral), Takahiro Fujiyama, Ken-ichi Sugimoto, and Michiru Sekiguchi, Mitsui Chemicals, Inc. (Japan)

Photoconductor Discharge Curves, the Stretched Exponential and Exponential Decay Functions (Oral), Eric Stelter, NexPress Digital LLC (USA)

Development of New α -Si Photoconductor Drum by DC Plasma CVD (Oral), Akihiko Ikeda, Takashi Nakamura, Masamitsu Sasahara, Daigoro Ookubo, and Tetsuya Kawakami, Kyocera Corporation (Japan)

A Semi-Empirical Model for Dip Coating: Thickness and Thickness Uniformity Control (Oral), Michel Frantz Molaire, NexPress Solutions, Inc. (USA)

High Performance Vertical Organic Transistor Using Sheet Metal Base (Focal), Shin-ya Fujimoto, Ken-ichi Nakayama, and Masaaki Yokoyama, Osaka University (Japan)

Photochromic Compounds and Recording Media for 3D Optical Memory (Oral), V. A. Barachevsky and M. M. Krayushkin, Photochemistry Center and Institute of Organic Chemistry of the Russian Academy of Sciences (Russia)

1:40 to 2:35 pm

Photo-electronic Materials and Devices (con't.)

Crystal Structure of a Soluble Quinacridone-precursor and its Thermal Regeneration into the Pigment (Oral), Takatoshi Senju, Yasuo Imura, Yasunobu Yamashita, and Jin Mizuguchi, Yokohama National University (Japan)

Electronic Structure of the Cis and Trans Isomers of Benzimidazo Perylene Derivatives and their Use as Black Pigments (Focal), J. Mizuguchi and N. Shimo, Yokohama National University (Japan)

A Pigment Precursor Based on Mono t-BOC Diketopyrrolopyrrole and its Thermal Regeneration into the Pigment (Interactive), Jin Mizuguchi, Yasuo Imura, and Takatoshi Senju, Yokohama National University (Japan)

3:05 to 5:00 pm

Electronic Paper and Paper-Like Display

Session Chairs: Michael Lee, Hewlett-Packard Company; Tom Ashley, Pivotal Resources USA; and Yasushi Hoshino, Nippon Institute of Technology

Molecular Design for Coloring/Decoloring Properties in Rewritable Paper Using Leuco Dyes: Effects of Long-chain Alkyl Group (Focal), Satoshi Yamamoto, Hiromi Furuya, and Kyoji Tsutsui, Ricoh Co., Ltd.; and Yousuke Bando, Takeshi Sadoshima, Satoru Ueno, and Kiyotaka Sato, Hiroshima University (Japan)

Flexible Bistable Reflective Cholesteric Displays (Oral), Joel C. Domino, Kent Displays Inc. (USA)

NanoChromics - White Electronic Displays at Last! (Oral), David Corr, NTERA Ltd. (Ireland)

The Application of Inkjet for the Printing of PDLC Display Cells (Oral), Jali Heilmann, VTT Information Technology (Finland)

Novel Display Method for Electronic Paper Using Electro Rheological Fluid (Interactive), Chiaki Asakawa, Makoto Omodani, Shuichi Maeda, Tokai University (Japan)

Estimation of TiO₂ Particle Electrophoresis by Measuring Reflectance Response (Interactive), Ryusho Kumekawa, Takeshi Hasegawa, Takayuki Sano, and Yasushi Hoshino, Nippon Institute of Technology (Japan)

Preparation of Microencapsulated Electrophoretic Ink Used for an Electronic Paper (Interactive), Tutomu Shimano, Sakiko Nakamura, and Takashi Kitamura, Chiba University (Japan)

Driving Voltage for Electrical Particle Movement in Toner Display (Interactive), Takashi Kitamura, Daisuke Takahashi, Tetsuya Yamamoto, and Sakiko Nakamura, Chiba University (Japan)

A Study on Readability as a Goal of Electronic Paper —Effects of Media Handling Styles (Interactive), Sho Okano and Makoto Omodani, Tokai University (Japan)

TRACK 2

9:20 am to 12:10 pm

Ink Jet Printing — Processes

Session Chairs: Hue Le, Picojet, Inc.; Werner Zapka, Xaar Jet AB; and Mineo Kaneko, Canon Inc.

Development of a Drop on Demand Piezoelectric Line Inkjet Printhead (Focal), Atsushi Hirota and Shin Ishikura, Brother Industries, Ltd. (Japan)

The Impact of Silicon MEMS on the Future of Ink Jet Printhead Design and Performance (Oral),

Amy Brady, Marlene McDonald, and Scott Theriault, Spectra, Inc. (USA)

High Throughput Inkjet Printheads (Oral),

Werner Zapka, XaarJet AB (Sweden); Mark Crankshaw, Xaar plc (UK); Birger Forsberg, Kjell Broström, Ingo Reinhold, and Philipp Bingger, Xaar Jet AB (Sweden)

Application of MEMS Technology in Inkjet Printhead Fabrication (Oral),

Ty Chen,

TridentHTW (USA)

New Developments in Epson's Inkjet Head Technology (Focal),

Junhua Zhang, Katsuhiko Okubo, and Takahiro Katakura, Seiko Epson Corporation (Japan)

Enabling Higher Jetting Frequencies for Inkjet Printheads Using Iterative Learning Control (Oral),

Matthijs Groot Wassink and Okko Bosgra, Delft University of Technology; and Marcel Slot, Océ-Technologies B.V. (The Netherlands)

1:40 to 3:05 pm

Ink Jet Printing — Processes (con't.)

A Control-Command Tool for Monitoring Piezoelectric Micro-Pumps (Oral),

M. J. Cittadino and E. Mendes, Laboratoire De Conception Et d'Intégration Des Systèmes, Ecole Supérieure D'ingénieurs en Systèmes Industriels Avancés; and A. Soucemarianadin, Laboratoire des Écoulements Géophysiques et Industriels, Université Joseph Fourier (France)

Droplet Formation and Dropping Position Control in Electrostatic Inkjet Phenomena (Oral),

Shinjiro Umezu, Hodaka Suzuki, and Hiroyuki Kawamoto, Waseda University (Japan)

UV Curing of Inks and Coatings in Digital Printing Applications (Oral),

John Maitland,

Nordson UV Ltd. (UK)

UV Lamp Design for Moving Printhead Inkjet Applications (Oral),

Adrian Lockwood,

Integration Technology Ltd. (UK)

The Application of the Inkjet Technology in Capsule Endoscope (Interactive),

Ching-Long Chiu, Yung-Fa Huang, Yen-Wen Sha, Zhao-Fu Tseng, and Chin-Tai Chen, OES/ITRI (Taiwan)

TRACK 3

9:20 am to 12:10 pm

Toner-Based Printing Materials — Quality Upgrade and Evaluation

Session Chairs: Dennis Abramsohn, Hewlett-Packard Company; Martin Schleusener, Océ Printing Systems; and Toshihiko Oguchi, Morimura Chemicals, Ltd.

Some Techniques on Electrostatic Classification of Particle Size (Oral),

Hiroyuki Kawamoto,

Waseda University (Japan)

Blue Angel Award Criteria for Electrophotographic Toner (Interactive),

Klaus Berger and

Toru Nakamura, Ticona GmbH (Germany)

Screening of Colorants for Electrophoto-

graphic Toners (Oral), *Billy Grierson, Ciba Specialty Chemicals (Scotland)*

Toner Charging Characteristics' Dependence on Toner Shape (Interactive),

Tsunenori Nakanishi, Kueiying Sheu, Jain-Sheng Huang, and Yasushi Hoshino, Nippon Institute of Technology (Japan)

Analysis of Tribo-charging Characteristics on Toner Particles in Two-Component Developer (Interactive),

Youichi Nakamura, Yasushi Hoshino, and Yutaka Terao, Nippon Institute of Technology (Japan)

Improved Separating Agent for Roller Fusing (Interactive),

Detlef Schulze-Hagenest, Nex-Press GmbH (Germany) and Dinesh Tyagi,

NexPress Solutions Inc. (USA)

The Quantitative Measurement of Pigment Dispersion by Fractal and Other Methods (Oral),

Gordon E. Hardy, Hunt Imaging (USA)

The Effect of External Toner Additives on the

Aging of Conductive Developers (Focal),

Robert Nash, K. Francis, and K. LaMora,

Xerox Corporation (USA)

Quantification of Toner Aging in Two-

component Development Systems (Focal),

Palghat S. Ramesh, Xerox Corporation (USA)

1:40 to 3:05 pm

Toner-Based Printing Materials — Quality Upgrade and Evaluation (con't.)

Standard Carrier for Blow-off Toner Charge Measurement (Interactive),

Toshihiko Oguchi, Morimura Chemicals Ltd.; Masatoshi Kimura and

Chiaki Suzuki, Fuji Xerox Co., Ltd.; Noboru Sawayama, Ricoh Co., Ltd.; Yasusuke Takahashi,

Tokai University; Manabu Takeuchi, Ibaraki

University; Tatsuya Tada, Canon Inc.;

Katsuyoshi Hoshino, Chiba University; Noboru

Ito, Konica Minolta Business Technologies

Inc.; Akira Shimada, Ricoh Printing Systems

Ltd; Yuji Sato and Hiromichi Kobayashi,

Powdertech Co., Ltd. (Japan)

Analysis of the Effect of an External Additive on Toner Charging in the Mono-component Non-magnetic Toner System by Measuring

Micro Current (Oral), *Hiroyuki Anzai and Koji*

Takagi, Bridgestone Corporation (Japan);

Manabu Takeuchi, The University of Ibaraki

(Japan); and G. S. P. Castle, The University of

Western Ontario (Canada)

The Effect of Silica Properties on Toner

Charge and Printing Quality (Oral), *Seok*

Hoon Choi, Duck Hee Lee, Sang Deok Kim,

and Kyung-Yol Yon, Samsung Electronics Co.,

Ltd. (Korea)

Performance Optimization of Functional

Fumed Metallic Oxide Based External Addi-

tives for Toner (Oral), *Akira Inoue, Yuki*

Amano, and Paul Brandl, Nippon Aerosil

Co., Ltd. (Japan)

Thermally Stimulated Current and Thermally

Stimulated Charge Decay Measurements in

Toner Layers (Oral), *Manabu Takeuchi,*

Kenichi Kutsukake, and Takao Sugihara,

Ibaraki University (Japan)

TUESDAY, SEPTEMBER 20, 2005

TRACK 1

8:00 to 9:30 am

Digital Art

Session Chairs: Annette Jaffe, Annette Jaffe Consulting, and Eric Stelter, NexPress Digital LLC

Overcoming 'Digital Stigma' in the Fine Art World: Legitimizing Digital Art by Debunking Common Misunderstandings (Focal), Robert McClintock, Baltimore Seen, Inc. (USA)

The Digital Fine Art Print: Opportunities and Challenges (Focal), Michael Berger, Wilhelm Imaging Research (USA)

Spectral Reproduction Research for Museums at the Munsell Color Science Laboratory (Focal), Mitchell Rosen and Roy Berns, Rochester Institute of Technology (USA)

1:30 to 5:05 pm

Print and Image Quality

Session Chairs: Paul Jeran, Hewlett-Packard Company; Shigeru Kitakubo, Nippon Institute of Technology; and Martin Smallegange, Stork Digital imaging BV

Perception Based Hardcopy Banding Metric (Focal), Yousun Bang, Samsung Advanced Institute of Technology (Korea); Zygmunt Pizlo and Jan Allebach, Purdue University (USA); and Norman Burningham, Hewlett-Packard Company (USA)

Compensation for Color Banding Artifact in Polychrome Electrophotographic Process Using Multiple OPC Drum Velocity Control Based on Psychometric Measurements (Oral), Mu-Chih Chen, George T. C. Chiu, and Jan P. Allebach, Purdue University (USA)

Image Graininess via Flat-bed Scanner and Image Segmentation (Oral), Yee S. Ng and Chung-hui Kuo, NexPress Solutions, Inc. (USA)

Gloss Colour Effects in Inkjet Printing – Attribute, Artefact or Defect? (Oral), Alan Hodgson, Alan Hodgson Consulting (UK)

Spot Color Reproduction with Digital Printing (Oral), Miro Suchy, Abhay Sharma, and Paul D. Fleming III, Western Michigan University (USA)

The DICOM Grayscale Standard Display Functi **Withdrawn** *n Medical Systems (USA)*

The Influence of Ink and Paper on Bar Code Print Quality and Readability with OCR Scanning Systems (Oral), Judith Auslander, Mike Chen, Robert Cordery, and Claude Zeller, Pitney Bowes; and Ming-Kai Tse, QEA (USA)

New Convex Print Technologies for the Blind (Interactive), R. Barczyk, D. Choromanska, and L. Buczynski, Warsaw University of Technology (Poland); and D. Mac Callum, Anglia Polytechnic University (UK)

Histogram Analyze as the Tool for Image Quality Estimation of Color Printouts (Interactive), L. Buczynski and R. Barczyk, Warsaw University of Technology (Poland)

The Ink Volume Based Resolution Conversion Method (Interactive), Hsiao-Yu Han, Meng-Fen

Lo, Yao-Wen Huang, Tung-Lin Wu, Jieh-Yee Huang, and Jane Chang, OES/ITRI (Taiwan)

Some Characteristics on Human Visual Sensitivity for Spatial Frequency of Digital Halftone Images (Interactive), Shigeru Kitakubo and Yasushi Hoshino, Nippon Institute of Technology (Japan)

Improvement of Digital Print in Preference by Adding Noise (Interactive), Takeshi Sato, Naokazu Aoki, and Hiroyuki Kobayashi, Chiba University; Masao Inui, Tokyo Institute of Polytechnics (Japan)

How We Look At Photographs (Interactive), Sharon Gershoni and Hiroyuki Kobayashi, Chiba University (Japan)

An Investigation into the Interaction Between Vinyl Thickness and Image Quality on Wide-Format Media (Interactive), Larry Wallace and Bill Kuhn, Cooley Group (USA)

TRACK 2

8:00 to 11:05 am

Ink Jet Printing — Materials

Session Chairs: Michael Viola, Cabot; Shinichi Kato, Epson Research and Development; and Hugh Allen, Coates

New Colorants for Ink Jet Printing of Digital Images (Oral), C. E. Foster and S. L. Leather, Avencia Ink Jet Printing Materials (UK)

Fixation of Pigmented Black Ink on Matte Coated Ink Jet Substrates (Oral), Wolfgang Storbeck, Daniella Dietrich, and Rita Schneider, Grace GmbH and Co. KG (Germany)

Plain Paper Quality of Color Pigmented Inks (Oral), Takehiro Tsutsumi, Makoto Sakakibara, and Ryuuma Mizushima, Kao Corporation (Japan)

Encapsulation Technology for Pigmented Inks (Focal), Xiaoru Jenny Wang, Eastman Kodak Company (USA)

Primers for UV Jet-inks (Oral), Alexander Grant, SunJet (UK)

UV Inkjet — Development of Unique Raw Materials (Oral), James S. Balcerski, William Dougherty, Jeffery Klang, and James Goodrich, Sartomer Company (USA)

Determination of the Colloidal Stability of Concentrated Pigment Dispersions (Oral), Yuan Yu, Cabot Corporation (USA)

Stability of Nonaqueous Ink-Jet Inks as Studied by Single-Particle Optical Sensing (Interactive), Caroline Hayes, Cabot Corporation (USA) and Iwao Teraoka, Polytechnic University (Japan)

1:30 to 4:25 pm

Image Permanence

Session Chairs: Douglas Bugner, Eastman Kodak Company; Takao Abe, Shinshu University; and Anne Blayo, EPPG

Sensitivities of Kodak's Xtralife Thermal Dye Transfer System Prints to Environmental Factors (Oral), Jeffrey C. Smitley, Brian Thomas, Richard P. Henzel, and Joseph E. La Barca, Eastman Kodak Company (USA)

Humidity Effects on Light Fastness Testing (Oral), Juerg Reber and Rita Hofmann, ILFORD Imaging Switzerland GmbH (Switzerland)
A Closer Look at the Effects of Temperature and Humidity on Inkjet Photographic Prints (Focal), Douglas Bugner and Brian Lindstrom, Eastman Kodak Company (USA)
Long-time Preservation of Digital Images on Microfilm (Oral), Andreas Hofmann and Cédric Normand, University of Basel (Switzerland)
Correlation Between Gas-resistance Testing Method and Image Deterioration in Indoor Displays (Focal), Yukihiko Kanazawa, Yoshio Seoka, Shinzou Kishimoto, and Yoshihiko Shibahara, Fuji Photo Film Co., Ltd. (Japan)
Dark Stability of Photographs — The Forgotten Parameter (Interactive), David F. Kopperl and Mark B. Mizen, Creative Memories (USA)
9-ink Printing Using Vivera Inks: Image Quality and Permanence on Photo-and Visual Art Media (Oral), Alexey Kabalnov, Luanne Rolly, and Jay Gondek, Hewlett-Packard Company (USA)

TRACK 3

8:00 to 10:30 am

Toner-Based Printing Processes

Session Chairs: Yee Ng, NexPress; Yusuke Takeda, Ricoh Co., Ltd.; and Marcel Slot, Océ

On Roller Charging of Photoreceptors for Electrophotography (Focal/Awards), Inan Chen and Ming-Kai Tse, Quality Engineering Associates (QEA), Inc. (USA)
Four-beam Scanning Optical System with a Converting Function of Seven-level Print-dot-densities (Oral), Takeshi Machizuki, Kazuhiro Akatsu, Jyunshin Sakamoto, and Yasushi Hashimoto, Ricoh Printing Systems, Ltd. (Japan)
Fine Image Quality by Using Small Size Full Color Chemical Toner and New Process Technologies (Focal), Masumi Sato and Akira Azami, Ricoh Company, Ltd. (Japan)
Numerical Simulation of Carrier Behavior Around a Magnet Roll in Two Component Developer Unit in Electrophotography (Oral), Takahiro Watanabe, Ricoh Company, Ltd. (Japan)
Property of Toner Layer on Developing Roller for Mono-Component Developing System (Oral), Akira Shimada, Masahiko Saitou, and Yuichiro Sano, Ricoh Printing Systems, Ltd. (Japan)

1:40 to 4:15 pm

Toner-Based Printing Processes (con't.)

Simulation of Toner Particle Movement Between a Cylindrical OPC and Developer (Oral), Jang Yi, Everett, Mass. (USA)
Numerical Simulation of Toner Movement in a Transfer Process (Focal), Masami Kadonaga, Tomoko Takahashi, and Haruo Imura, Ricoh Company, Ltd. (Japan)
Development System by Toner Transportation Using Traveling Wave Electric Field

Interactive Paper Sessions

Tuesday & Thursday 4:30 to 6:30 p.m.

Oral previews of Interactive Papers are given within Technical Sessions. See those papers flagged “(Interactive).”

Presentations that benefit from closer scrutiny of image results have been assigned to one of two Interactive Paper Sessions. This alternative presentation style is always a highlight of the conference and a great opportunity for one-on-one discussion with authors. Five-minute oral previews of each paper are scheduled within the appropriate oral session as noted by the “(Interactive)” notation after the paper title. These presentations give attendees the opportunity to determine which presenters to visit during the two Interactive Paper Sessions.

Interactive Papers previewed in sessions on Monday and Tuesday will be available for viewing and discussion Tuesday, from 4:30-6:30 pm. Those previewed on Wednesday and Thursday will be available for viewing and discussion Thursday, from 4:30-6:30 pm. Light refreshments will be served.

(Oral), Katsumi Adachi, Shinji Yamana, Tadashi Nakamura, and Yoshiharu Ueki, Sharp Corporation (Japan)
Analysis of the Magnetic Force Acting on the Toner Using Finite Element Method in Longitudinal Recording Magnetography (Oral), Norio Kokaji, Meisei University (Japan)
NexPress Glosser Process for Photo-Rich Applications (Oral), Muhammed Aslam and Yee S. Ng, NexPress Solutions, Inc. (USA)
Dot Formation Condition from the Conductive Toner Cloud by Aperture Electrodes (Interactive), Ye Zhou and Yasushi Hoshino, Nippon Institute of Technology (Japan)
Analysis of the Tribocharging Mechanism and the Surface Properties of a Development Roller in an Electrophotographic Toner Development System (Interactive), Koji Takagi, Bridgestone Co. (Japan); G. S. P. Castle, University of Western Ontario (Canada); and Manabu Takeuchi, Ibaraki University (Japan)
A Simulation Model for Estimation of Ficker Levels Induced by On-Off Switching of a Halogen Heater of a LBP Fuser (Interactive), Masataka Maeda, Ibaraki University (Japan)

WEDNESDAY, SEPTEMBER 21, 2005

TRACK 1

9:20 am to 12:10 pm

Printing Systems Engineering and Optimization

Session Chairs: Peter Paul, Xerox Corporation; Hiroyuki Kawamoto, Waseda University; and Paul Morgavi, Impika

Productivity Analysis of a Scanning Inkjet Printer (Focal), Dennis Bruijnen and René van de Molengraft, Technische Universiteit Eindhoven; Aswin Draad and Theo Heeren, Océ Technology BV (The Netherlands)

A Novel Approach to Printhead Alignment for Wide Format Printers (Oral), Scott Cole, Kate Johnson, and Yair Kipman, ImageXpert Inc. (USA)

Temperature Control in Thermal Inkjet Printers (Oral), Pere Canti, Hewlett-Packard (Spain)

Optimizing the UV Ink Jet Curing Process (Oral), R. W. Stowe, Fusion UV Systems, Inc. (USA)

Sound Quality Discrimination of the Impulsive Sounds with Mahalanobis' Distance (Oral), Koji Udagawa and Yumiko Kurosawa, Fuji Xerox Co., Ltd. (Japan)

Advanced Intermediate Transfer Belt Mechanism Driven by Photoconductor Belt (Focal), Shunichi Oohara, Kazuhiro Wakamatsu, and Atsushi Onose, Ricoh Printing Systems, Ltd. (Japan)

1:30 to 3:35 pm

Printing Systems Engineering and Optimization con't.

Parameterized Printer Model for Rendered Gray Level Images (Oral), Vivek Jaganathan and Raghuvver Rao, Rochester Institute of Technology; and Aaron Burry and Peter Paul, Xerox Corporation (USA)

Digital Glossing, its Applications and Performance Evaluation (Oral), C. Jeffrey Wang, NexPress Solutions, Inc. (USA)

Construct of a Supersystem for Capture to Output (Oral), Nader Anvari, Eastman Kodak Company (USA)

Quantification of Color Variation Introduced During Premedia Production (Oral), Michael Riordan, RIT School of Print Media (USA)

Analysis on Behavior of Optical Based Toner Level Sensing Technology (Interactive), Hong Ren, Larry Stauffer, Santiago Rodriguez, and Thom Ives, University of Idaho (USA)

Tone Curve Stabilization for Color Electrophotography (Interactive), Kenji Totsuka, George T.-C. Chiu, and Dennis Abramsohn, Purdue University (USA)

Silicone Sycar® Hybrid Adhesives for Harsh Fluid Resistant (Interactive), Susan Krawiec, Elizabeth Walker, Robert Palmer, Chih-Min Cheng, and Kate Pearce, Emerson & Cuming (USA)

TRACK 2

9:20 am to 12:15 pm

Color Science and Image Processing

Session Chairs: Charles Bouman, Purdue University; Kazuhisa Yanaka, Kanagawa Institute of Technology; and Joan Uroz, Hewlett-Packard Company

Stochastic Screening — Been There - Done That? (Oral), Tony Harris, Software Imaging (UK)

Optimization of Color Dyes for Spectral and Colorimetric Color Reproduction (Oral),

Takayuki Ogasahara, Canon Inc. (Japan)

What Has Been Overlooked in Kubelka-Munk Theory? (Focal), Li Yang, Karlstad University (Sweden)

A Novel Picture Coding Using Colorization

Technique (Oral), Megumi Nishi, Takahiko Horiuchi, and Hiroaki Kotera, Chiba University (Japan)

Black Color Replacement using Gamut Extension Method (Interactive),

Byoung-Ho Kang, Heui-Keun Choh, and Chang-Yeong

Kim, Samsung Advanced Institute of Technology (Korea)

An Integrated Color Halftone Method for Noise Reduction (Interactive), Hung-Pin Shih, OES/ITRI (Taiwan)

Method of Printing Images Using Multiple Colorants Having Different Saturation Based on an Experiment About Ink Control (Interactive), Tung-Lin Wu, OES/ITRI (Taiwan)

Content-Based Color Image Retrieval Using Multi-Variate Feature Vectors (Oral), Hideaki Kokubun and Hiroaki Kotera, Chiba University (Japan)

A Region-based Automatic Scene Color Interchange (Oral), Yoshifumi Matsusaki, Hiroaki Kotera, and Ryoichi Saito, Chiba University (Japan)

1:30 to 4:25 pm

Color Science and Image Processing (con't.)

A Digital Halftoning Using Magic Square

(Oral), Hiroaki Kotera, Fugen Jin, and Takahiko Horiuchi, Chiba University (Japan)

A Versatile Gamut Mapping for Various Devices (Focal), Ryoichi Saito and Hiroaki Kotera, Chiba University (Japan)

Image Segmentation Using Expectation

Maximization and Its Application to Digital Copying (Oral), Mohamed Nooman Ahmed, Lexmark International (USA)

A Black Point Compensation Method for the Black-to-Gray Problem of CMYK Profiles (Interactive), Bin Ma,^{1, 2} Allan Nengsheng Zhang,^{1, 2} and Winson Lan;² ¹Singapore Institute of Manufacturing Technology and

²KiKUZU Solutions Pte Ltd. (Singapore)

The New Challenges for Color Management in Digital Printing (Oral), Allan N. S. Zhang,^{1, 4} Kamal T. Youcef,² Andrew Y. C. Nee,³

Winson Lan,⁴ and Bin Ma;¹ ¹Singapore Institute of Manufacturing Technology (Singapore), ²Massachusetts Institute of Technology (USA), ³National University of Singapore (Singapore), and ⁴KiKUZU Solutions Pte Ltd. (Singapore)

Generating Digital Image of Ukiyoe by Applying the Kubelka-Munk Theory (Interactive), Tomotaka Hirokawa, Junko Tanabe, Yoshihiko Azuma, and Masao Inui, Tokyo Polytechnic University (Japan)

Generation of Integral Photography Images Using LightWave 3DTM (Oral), Kazuhisa Yanaka, Takumi Taiko, and Hideo Kasuga, Kanagawa Institute of Technology (Japan)

A Psychophysical Evaluation of a Gamut Expansion Algorithm Based on Chroma Mapping (Interactive), Toyoshi Marioka, Yoshihiko Azuma, and Masao Inui, Tokyo Institute of Polytechnic (Japan)

A Model of Printer Characterization Dependent on Tonal Variation (Oral), Swati Bandyopadhyay, Jadavpur University, and Tapan Paul, ABP Pvt. Ltd Kolkata WB (India)

TRACK 3

9:20 to 10:40 am

Invited Session: Nanotechnology in Imaging Science and Instrumentation

Session Chair: Ramon Borrell, Hewlett-Packard Española SL

Optical Near Field Methods (Invited), Rolf Eckert, Centre Suisse d'Electronique et de Microtechnique CSEM SA (Switzerland)

Scanning Probe Microscopy for Imaging Magnetic and Ferroelectric Patterns on a Nanoscale (Invited), Guido Tarrach, SwissProbe AG (Switzerland)

11:10 am to 12:25 pm

Toner-Based Printing Materials — Innovative Processes

Session Chair: Denesh Tyagi, NexPress; Manabu Takeuchi, Ibaraki University; and Dettel Schulze-Hagenest, NexPress GmbH

Aqueous Dispersions of High-dispersion Polystyrene (Interactive), Iryna Ye. Opatnych and Zenovii M. Yaremko, Ivan Franko L'viv National University (Ukraine)

Behavior of Charge Control Agent (CCA) in Two-component Developer (Oral), Atsushi

Suka and Manabu Takeuchi, Ibaraki University; and Keiki Suganami and Toshihiko Oguchi, Morimura Chemicals Ltd. (Japan)

Advanced Color Toner for Fine Image Quality II (Oral), Akihiro Eida, Shinichiro Omatsu, and Jun Shimizu, Kao Corporation (Japan)

Océ's Mono-Component, Magnetic, Conductive Colour Toner (Focal), Marcel Everaars, Océ-Technologies B.V. (The Netherlands)

1:40 to 2:50 pm

Toner-Based Printing Materials — Innovative Processes (con't.)

Preparation of Pigment-Containing Polyester Toner by Chemical Milling (Oral), Chul-Hwan Kim, Bae-Kun Shin, Il-Soon Shin, Eui-Joon Choi, and Hyun-Nam Yoon, DPI Solutions, Inc. (Korea)

Study of the Factors for the Morphological Control of the Chemically Prepared Toner (Oral), Jun-Young Lee, Chang-Kook Hong, Sang-Woo Kim, Sang-Deok Kim, and Kyung-Yol Yon, Samsung Electronics Co., Ltd. (Korea)

Development of New Polymerization Full-Color Toner (Focal), Fumihiro Sasaki, Satoshi Mochizuki, Akihiro Kotsugai, Sonoh Matsuoka, Yasuo Asahina, Osamu Uchinokura, Yasuaki Iwamoto, Hisashi Nakajima, Shinya Nakayama, Masahiko Ishikawa, Takuya Saitoh, and Kohichi Sakata, Ricoh Company, Ltd. (Japan)

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Please note:

Panel Discussion: Intellectual Property

takes place from 4:15 – 6 pm at the Hyatt Regency Baltimore on Wednesday, September 21st.

The panel will address the impact of national and international law on innovation in imaging and important aspects in patent, copyright and trademark protection. For more details see page 8.

THURSDAY, SEPTEMBER 22, 2005

TRACK 1

9:20 am to 12:00 pm

Thermal Printing

Session Chairs: Fariza Hasan, Polaroid Corporation; Hirotoishi Terao, Alps Electric Co., Ltd.; and Ian Stephenson, ICI Imagedata

A New, Full-Color, Direct Thermal Imaging System (Focal), Stephen J. Telfer, Polaroid Corporation (USA)

Multi Color Thermal Imaging by One-pass Printing with a Single Printhead (Oral), Fariza B. Hasan, Richard M. Allen, and Michael G. Dowling, Polaroid Corporation (USA)

Development of Digital Photo Prints on Thermal Dye Transfer Method (Oral), Masafumi Hayashi and Daisuke Fukui, Dai Nippon Printing Co., Ltd. (Japan)

Full Colour Fluorescent Images Printed by Thermal Dye Transfer (Oral), Richard A. Hann and Ian R. Stephenson, ICI Imagedata (UK)

Colorless Crystals of Tautomeric Fluoran Indicator Dyes (Oral), Michael P. Filosa and John L. Marshall, Polaroid Corporation (USA)

Design of Thermal Printhead by Contact Pressure Analysis (Oral), Hirotoishi Terao, Alps Electric Co., Ltd. and Isami Nitta, Niigata University (Japan)

1:30 to 1:50 pm

Thermal Printing (con't.)

Conductive Circuit Pattern Printed by Thermal Transfer Technology (Interactive), Katsuhiro Yoshida and Yukinari Ishida, General Co. (Japan)

Latest Technology of Thermal Printhead (Interactive), Tadayoshi Yamamoto, Rohm Co., Ltd. (Japan)

On the Density-dependence of Sharpness for Thermal Print Media (Interactive), Dirk W. Hertel and Suhail S. Saquib, Polaroid Corporation (USA)

Model-based Estimation of Heating Element Temperature Using Resistance Measurement (Interactive), Suhail S. Saquib and Brian Busch, Polaroid Corporation (USA)

2:20 to 4:20 pm

Security and Forensic Printing

Session Chairs: Annette Jaffe, Annette Jaffe Consulting and Tony Harris, Software 2000

ID Card Printing – Is Your Process Secure? (Oral), Alan Fontanella, Fargo Electronics (USA)

“Rolicure™ Pearl:” An Optically Variable Device for Security Applications (Oral), M. Stalder, F. Moia, and F. Seils, Rolic Technologies Ltd. (Switzerland)

Printer Forensics Based on Texture Features (Oral), Aravind K. Mikkilineni, Osman Arslan, Pei-Ju Chiang, Roy M. Kumontoy, Edward J. Delp, Jan P. Allebach, and George T. Chiu, Purdue University (USA)

Digital Printing and Bank Note Image Policy

(Oral), Martine Lacelle, Michael Duncan, and Sara Church, Bank of Canada (Canada)

Extrinsic Signature Embedding in Text Document Using Exposure Modulation for Information Hiding and Secure Printing in Electrophotography (Oral), Pei-Ju Chiang, Aravind K. Mikkilineni, Osman Arslan, Roy Moshe Kumontoy, George T.-C. Chiu, Edward J. Delp, and Jan P. Allebach, Purdue University (USA)

Identification of Inkjet Printers for Forensic Applications (Oral), Osman Arslan, Roy Moshe Kumontoy, Pei-Ju Chiang, Aravind K. Mikkilineni, Jan P. Allebach, George T. C. Chiu, and Edward J. Delp, Purdue University (USA)

TRACK 2

9:20 to 11:30 am

Media for Digital Printing

Session Chairs: Sen Yang, International Paper; Shuichi Maeda, Oji Paper; and Florian Eder, Neusiedler

Can Digital Prints Be Recycled? (Focal), Axel Fischer, INGEDE (International Association of the Deinking Industry) (Germany)

Silica Nanoparticles: Design Considerations for Transparent Inkjet Coatings (Oral), Natalia V. Krupnik, Beate Stief, Michael R. Sestrick, and Demetrius Michos, W. R. Grace & Co. (USA)

The Price of Cost Savings in Matte Ink-jet Coating Colours (Oral), Gemma Morea-Swift, Ineos Silicas Ltd. (UK) and Stephanie E. Rose, Ineos Silicas Ltd. (USA)

Ink Dot Formation in Coating Layer of Ink-jet Paper with Modified Calcium Carbonate (Oral), Dmitry Ivutin, Toshiharu Enomae, and Akira Isogai, University of Tokyo (Japan)

Engineered Pigments for Inkjet Receptive Media (Interactive), Annmarie Superka, Specialty Minerals Inc. (USA)

A Preparation of Spherical Calcium Carbonate and Application to Paper (Interactive), Yohita Mori, Toshiharu Enomae, and Akira Isogai, University of Tokyo (Japan)

1:40 to 3:50 pm

Media for Digital Printing con't.

Mechanism of Adhesion of HP Indigo Ink to Coated Papers (Focal), Steven Webb, Marc Aronhime, and Peter Forgacs, Hewlett-Packard Company (USA)

New Ink Jet Photographic Media (Oral), Hiroyuki Onishi, Seiko Epson (Japan)

Gelatine for Mat Inkjet Paper (Oral), Berthold Köhler, DGF STOESS AG (Germany)

The Water Resistance of Aqueous Ink Jet Graphics and Factors Pertaining to Media Design (Oral), Andrew Naisby and Julie List, Ciba Specialty Chemicals (USA)

Relation between the Thickness of Ink Receiving Layer and Color Image Quality, Physical Properties (Interactive), Tai Sung

Kang, Sang Hun Kim, Hee Yong Son, Hyung Woong Ryu, and Seog Jung Lee, Research Center of Hanmi Filmtech Co., Ltd. (Korea)
Estimation of Influence of Media's Surface Topology on Image Quality (Interactive), Sergey Gnatiuk, Andrey Lihatchev, Maxim Domasev, and Sergey Shavkun, St.Petersburg State University of Cinema and Television (Russia)

TRACK 3

9:20 to 11:20 am
Sensors in Imaging

Session Chair: Jin Mizuguchi, Yokohama National University

C-MOS-based Image Sensor (Invited), Shunsuke Inoue, Canon Inc. (Japan)
The Current of CCD Image Sensor Development (Invited), Tetsuo Yamada, Electronic Device Laboratories, Fuji Photo Film Co., Ltd. (Japan)
Sensors for Computed Radiography (Invited), Paul Lebrans, Agfa-Gevaert Group (Belgium)

1:40 to 4:40 pm

Production Digital Printing

Session Chair: Eric Stelter, NexPress Solutions Inc.
Satisfaction Level of Production Digital Color Printer Owners (Focal), Andrew Gordon, Charlie Corr and Jim Hamilton, InfoTrends/CAP Ventures (USA)
Xeikon Web Based Digital Printing — The Evolution of its Core Technologies (Focal), Dirk Broddin, Danny Smolders, Herman Van de Straete, Eric Soulliaert, and Frank Deschuytere, Xeikon International (Belgium)
The Xerox Nuvera™ 120 Digital Copier/Printer (Focal), David Craig, Patrick Pendell, Anthony M. Federico, Xerox Corporation (USA)
Konica Minolta's Production Printing System (Focal), Akihiro Owada, Konica Minolta Business Technologies, Inc. (Japan)
The NexPress 2100 and Commercial Printing Applications (Focal), Penny Pankow, NexPress Solutions Inc. (USA)

FRIDAY, SEPTEMBER 23, 2005

TRACK 1

9:20 am to 12:00 noon
Industrial and Textile Printing

Session Chair: Hitoshi Ujiie, Philadelphia University; Masahiro Hosoya, Toshiba Corporation; and Jan van Laethem, Agfa-Gevaert Group

Integration of the Fabric Formation and Printing Processes (Focal), Brian R. George, Deanna Wood, Swapnil Nandedkar, Hitoshi Ujiie, Muthu Govindaraj, Monica Fruscello, and Alexa Tremere, Philadelphia University (USA)

Water-based Pigment Inks for Textile Printing (Oral), Deverakonda Sarma and Steve Liker, Trident (USA)

The Use of Inkjet to Create Direct Write Conductive Features (Oral), Philip Bentley, Xennia Technology Ltd. (UK)

New Methods for Digital Fabrication of Printed Circuits (Oral), Peter H. Roth, Epic Research, Inc. (USA)

Electrophotography as a Means of Microfabrication: The Role of Electrodynamic and Electrostatic Forces (Oral), M. Cristina de Jesus, Donald S. Rimai, David J. Quesnel, and David S. Weiss, NexPress Solutions, Inc. (USA)

Image Quality of Inkjet Printing on Polyester Fabrics (Oral), Heungsup Park, Wallace W. Carr, Hyunyoung Ok, James Hardin, and Soomin Park, Georgia Institute of Technology (USA)

TRACK 2

9:20 to 11:20 am
Digital Printing — Quality Control Instrumentation

Session Chairs: Lalit Mestha, Xerox Corporation; Masahiko Itaya, Samsung; and Guido Desie, Agfa-Gevaert

Software for Absolute Correction Color Values and Calibration of Spectrometers (Oral), Jack A. Ladson and Hugh S. Fairman, Color Science Consultancy (USA)

Diagnostic Technique for Real-Time Measurement of Optical and Scan Properties of Optical Printheads (Oral), Jeffrey L. Guttman and Razvan Chirita, Photon, Inc. (USA)

Improvements in Toner Fines Characterization (Oral), Kevin Lofftus, NexPress Solutions, Inc. (USA)

Automating Quality Analysis: Toward a New Paradigm in Ink and Toner Assessment (Oral), Ronald Rezachek, Katun Corporation (USA)

Distinctness of Image (DOI) of Inkjet Photo Papers (Oral), Ming-Kai Tse and John C. Briggs, Quality Engineering Associates (QEA), Inc.; and Tom Graczyk, Arkwright, Inc. (USA)

Gray Balance Control Loops for Digital Color Printing Systems (Oral), Lalit K. Mestha, R. Enrique Vituro, and Yao Rong Wang, Xerox Corporation, and Sohail A. Dianat, Rochester Institute of Technology (USA)

Comparison of 1-D, 2-D and 3-D Printer Calibration Algorithms with Printer Drift (Focal), P. K. Gurram and Sohail A. Dianat, Rochester Institute of Technology; and Lalit K. Mestha and R. Bala, Xerox Corporation (USA)

NIP21/DF 2005 Technical Registration

Name _____
 Title/Position _____
 Company _____
 Mailing Address _____
 Telephone _____ Fax _____ Email _____

NIP21—September 19-23 (Hyatt Regency Baltimore)
Digital Fabrication 2005—September 19-22 (Sheraton Inner Harbor)
Tutorial Program—September 18-21 (Hyatt Regency Baltimore)
Exhibition—September 20 & 21 (Hyatt Regency Baltimore)

Conference registration includes admission to all regular sessions for both conferences, a choice of conference Proceedings, entrance to the exhibit, coffee hours, and ticketed receptions. Separate registration fees are required for tutorials. Guest/spouse registration includes continental breakfast Monday-Thursday and the Ice-Breaker and Conference receptions.

My primary focus is ____ DF 2005 ____ NIP21 track 1 2 3 (please circle primary track)
 (check the conference in which you plan to spend most of your time; you will receive the proceedings for this conference)

Please help us plan for your comfort by filling in the information below.

____ I also plan to attend some Digital Fabrication papers on ____ Tues ____ Wed ____ Thurs
 ____ I also plan to attend some NIP21 papers on ____ Mon ____ Tues ____ Wed ____ Thurs ____ Fri
 Circle the NIP Track(s) you plan to attend: 1 2 3

Conference Registration (CHECK ONE)	until 8/26	after 8/26	TOTAL
____ IS&T Member	\$565	\$610	\$ _____
____ Non-member	\$675	\$720	\$ _____
____ IS&T Student Member (ID required)	\$135	\$165	\$ _____
____ Student Non-member	\$165	\$195	\$ _____
____ IS&T Speaker/Session Chair Member	\$450	\$495	\$ _____
____ Speaker/Session Chair Non-member	\$545	\$590	\$ _____
special advance purchase and on-site rates for Proceedings:			
____ Extra NIP21 Proceedings book		\$50	\$ _____
____ Extra Digital Fabrication 2005 Proceedings book		\$50	\$ _____
____ Guest/spouse registration (Name: _____)		\$70	\$ _____

Tutorial Registration (be sure to multiply number of classes by per course fee and place on total line)

____ 2-hour IS&T Member (per class)	\$160	\$190	\$ _____
____ 2-hour Non-member (per class)	\$210	\$240	\$ _____
Check all that apply: <input type="checkbox"/> T05 <input type="checkbox"/> T06 <input type="checkbox"/> T07 <input type="checkbox"/> T08 <input type="checkbox"/> T013 <input type="checkbox"/> T14 <input type="checkbox"/> T20 <input type="checkbox"/> T21			
____ 4-hour IS&T Member (per class)	\$240	\$270	\$ _____
____ 4-hour Non-member (per class)	\$290	\$320	\$ _____
Check all that apply: <input type="checkbox"/> T01 <input type="checkbox"/> T02 <input type="checkbox"/> T03 <input type="checkbox"/> T04 <input type="checkbox"/> T09 <input type="checkbox"/> T10 <input type="checkbox"/> T12 <input type="checkbox"/> T15 <input type="checkbox"/> T16 <input type="checkbox"/> T17 <input type="checkbox"/> T18 <input type="checkbox"/> T19 <input type="checkbox"/> T22 <input type="checkbox"/> T23 <input type="checkbox"/> T24 <input type="checkbox"/> T25			
____ 8-hour IS&T Member: T11	\$365	\$395	\$ _____
____ 8-hour Non-member: T11	\$415	\$445	\$ _____

Exhibitor Registration (CHECK ONE)	until 6/30	after 6/30	
____ Exhibit Booth*	\$1815	\$1965	\$ _____
____ Exhibit Tabletop*	\$1155	\$1305	\$ _____

(*Includes one Technical Session Pass; Name for Technical Badge if different than above: _____)

____ IS&T Membership: \$95 US / \$105 overseas / \$25 Student \$ _____

join now and calculate your fees based on membership rates; membership paid for now expires 12/31/06

GRAND TOTAL \$ _____

Payment Method: Check (Check # _____) AMEX MC VISA Diner's Discover
 Card#: _____ Exp. Date: _____

Name as it appears on card: _____

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Baltimore, Maryland • September 18–23

NIP21/DF 2005 Hotel Registration

Name _____

Company _____

Mailing Address _____

Telephone _____ Fax _____ Email _____

Arrival Date and Time _____ Departure Date _____

(Reservations Deadline: August 18, 2005)

A special block of rooms at a discounted rate is being held at the Hyatt Regency Baltimore and Sheraton Inner Harbor hotels in Baltimore for IS&T attendees for the nights of September 17 – 23. The discounted rate will be extended for 3 days before and after these dates, based on availability. Early reservations are assigned on a priority basis to conference attendees provided they are received by August 18, 2005. To guarantee a room, a deposit equal to one night's housing must accompany a reservation request.

Deposits can be made by check or a major credit card.

Payment Method: ___ Check (check # _____ is enclosed).

___ AMEX ___ MC ___ VISA ___ Diner's ___ Discover

Card# _____ Exp. Date _____

Charge Authorization Signature _____

Notice of cancellation must be given to the hotel 72 hours prior to arrival date to receive a full refund of deposit. Be sure to obtain a cancellation number.

Check in is 4:00 pm. Check out is noon. There is no charge for children under 18 years when sharing a room with a parent with existing bedding. Please advise us of any change in date or plan.

Digital Fabrication 2005

September 19-22, 2005

Sheraton Inner Harbor, Baltimore, Maryland
(Headquarter Hotel)

Please reserve my room at the
Sheraton Inner Harbor
300 South Charles Street

Rates are per day;
add 12.5% tax to room rates as quoted below

___ Single Room - \$169

___ Double Room - \$169

___ Triple Room - \$189

___ Quadruple Room - \$209

Special requirements: _____

Reservations: 800/325-3535 or 410-962-8300
Fax (410/962-8211) or mail this form to
Reservations Manager
Attn: IS&T's Digital Fabrication 2005
Sheraton Inner Harbor
300 South Charles Street
Baltimore, Maryland 21201

NIP 21

September 19-23, 2005

Hyatt Regency Baltimore
(Headquarter Hotel)

Please reserve my room at
Hyatt Regency Baltimore
300 Light Street

Rates are per day;
add 12.5% tax to room rates as quoted below.

___ Single Room - \$175

___ Double Room - \$175

___ Triple Room - \$200

___ Quadruple Room - \$225

Special requirements: _____

Reservations: 888/421-1442 or 410/528-1234
Fax (410/685-3362) or mail this form to
Reservations Manager
Attn: IS&T's NIP21
Hyatt Regency Baltimore
300 Light Street
Baltimore, Maryland 21202

NIP 21/Digital Fabrication 2005 Exhibitors

The exhibit hall will be open on Tuesday, September 20th from 9:30 am to 5:00 pm and Wednesday, September 21st from 9:00 am to 4:00 pm. Please join us.

The following lists exhibitors as of June 28, 2005.

7-SIGMA

Cabot Corporation
Ciba Specialty Chemicals
Clariant Corporation
Degussa AG
Emerson and Cuming
Epping GmbH
Esprit Technologies
Flow Science, Inc.
Foley & Lardner
Grace Davison
Hodogaya Chemical
Hosokawa Micron Powder Systems
ImageXpert, Inc.
Imaging Technology International Corp. (ITI)
Information Management Institute, Inc.
International Specialty Products

KB America, Inc./Boeffcher Systems
Kyocera Industrial Ceramics Corporation
Membrana
MicroFab Technologies, Inc.
Orient Chemical Industries, Ltd.
Pall Corporation – Pall Microelectronics
Pivotal Resources Ltd.
Powdertech International
Q-Panel Lab Products
Quality Engineering Associates (QEA), Inc.
Saint-Gobain Performance Plastics
Schlegel Systems, Inc.
Schott AG
Sci-Tec, Inc.
Sensient Technical Colors
Software Imaging
TREK, Inc.
Wacker-Chemie GmbH
Winfield Industries, Inc.
XINK Laboratories Ltd.

For further information about exhibiting at NIP21 contact Exhibit Chair, Laura Kitzmann (laura.kitzmann@sensient-tech.com).

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