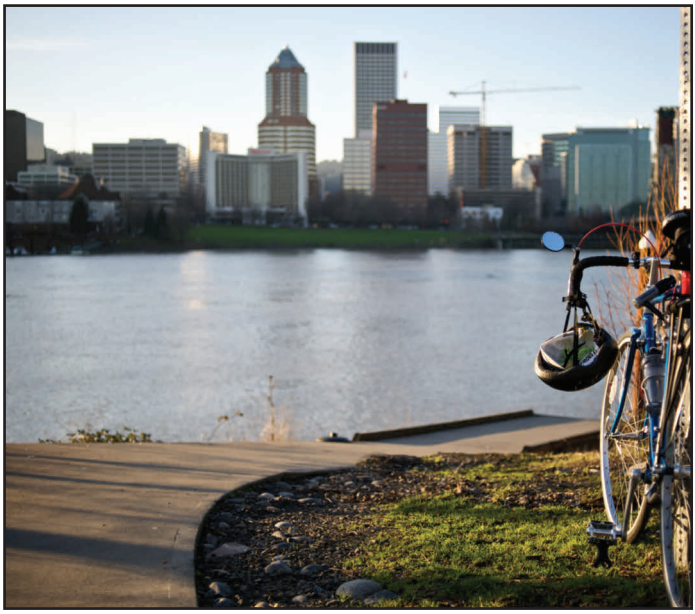
PRELIMINARY PROGRAM

more than printing

Digital Fabrication and Digital Printing

NIP31

September 27 – October 1, 2015
Portland, Oregon



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General Chair: Masahiko Fujii, Fuji Xerox Co. Ltd.

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Keep up-to-date on the details of these meetings! Join the NIP (Digital Printing)/Digital Fabrication Conference Group on LinkedIn!

Short Course Program

The conference Short Course Program offers a wide range of introductory and advanced classes in the fields of digital printing and fabrication given by internationally recognized experts. Attendees receive e-copies of the instructor's notes with course registration. We encourage you to sign up for short courses by the early registration deadline to ensure that a course runs.

Please Note: IS&T reserves the right to cancel short courses in the event of insufficient advance registration. Please indicate your interest early.

Sunday September 27, 2015

Short Course Monitors are needed to help with classes. Monitors take courses for free. Interested? Contact Diana Gonzalez at nip_df@imaging.org. Priority is given to students.

SC01-S1: Recent Advances in Nanotechnology

Sunday 8:00 – 10:00 am (2 hours)
Instructor: Kock-Yee Law, Research and Innovative Solutions

Nanotechnology is the frontier of science, engineering, and manufacturing technologies. This short course intends to provide an overview of this vast field. The course begins with a conversation on the history, evolution, economic, and social impacts of nanotechnology, followed by a critical review of key research/technology areas, including carbon nanotubes, graphenes, nanoparticles, nanocomposites, and superhydrophilic and superhydrophobic self-cleaning surfaces, etc. The research trends, potential applications and outlook of these nanomaterials and devices are summarized. The opportunity to leverage recent advances in nanotechnology to fuel innovations in digital printing will be discussed.

Benefits

This course enables an attendee to:

- Benefit by seeing the entire landscape of this field as well as an overview of the advanced research and social impact.
- Become familiar with the field, especially managers and executives by enabling them to apply this knowledge in the workplace.
- Broaden their knowledge base and may lead to the creation of cross-discipline research areas in the future.

Intended Audience: scientists, engineers, managers, and executives from both industry and academia will find it beneficial.

Kock-Yee Law is the founder of Research and Innovative Solutions, a global technical and education provider to the high-tech industry. He is an associate editor for Surface Innovations and also on the editorial board for Advances in Colloid and Interface Science. Law has been organizer and chair for Symposia at the NSTI Nanotech conferences since 2010. Prior to Research and Innovative Solutions, he conducted research in many different fields and held various management positions at Xerox Webster.

SC02-S1: An Introduction to Digital Fabrication: Methods, Materials, and Applications

Sunday 8:00 – 10:00 am (2 hours)
Instructor: James W. Stasiak, Hewlett-Packard Company

During the past decade, there has been a remarkable convergence of two disparate technologies: digital printing of text and images and the fabrication of physical objects. This convergence, a blending of traditional printing methods with recent advances in materials science and with established manufacturing methods, has brought about the foundation of a new technology: digital fabrication.

Already, digital fabrication approaches are enabling new discoveries at the laboratory bench and are beginning to provide new efficiencies and unprecedented product customization on the manufacturing floor. In the near future, digital fabrication methods—along with the development of "functional inks"—will make it possible to print complete electronic circuits, optical devices, mechanical structures, and even new biological materials. The objective of this short course is to provide an introduction to the rapidly emerging science and technology of digital fabrication. The course includes an up-to-date overview of the methods, materials, and processes that are reshaping manufacturing and enabling new commercial applications in electronics, MEMS, and the life sciences. Finally, the class examines factors that are moving digital fabrication from a niche technology toward a new manufacturing paradigm.

Benefits

This course enables an attendee to:

- Develop an understanding of different digital fabrication methods and materials.
- List and compare different applications that range from printed electronics to the life sciences.
- Evaluate the technological issues and challenges of digital fabrication.
- Develop an understanding of the technology landscape, key players, and practitioners.

- Recognize the market opportunities addressed by this emerging technology.

Intended Audience: this is a survey course for engineers, scientists, and technical marketing professionals who are working or are interested in digital fabrication and printed electronics.

James Stasiak is currently a principal scientist in Hewlett-Packard's Technology Development Laboratory in Corvallis, Oregon. He is actively involved in developing new digital fabrication methods and applications. In a career spanning more than 30 years, he has made contributions in the fields of device physics, molecular electronics, non-impact printing technologies, and, more recently, the emerging fields of flexible electronics and digital fabrication. In 2005 and 2006, he served as the general chair for the Digital Fabrication Conference and now serves on the Digital Fabrication Conference Advisory Committee. He holds more than 14 issued US patents and is the author or editor of numerous technical articles and proceedings.

SC03-S1: Fabrication Materials & Processes of Ink Jet Printheads

Sunday 8:00 – 10:00 am (2 hours)
Instructor: Hue Le, Le Technologies Inc.

In recent years, enormous progress has been made in the design, fabrication, and commercialization of ink jet printing systems. This short course describes the materials and processes that have been used to produce various ink jet printheads, which are 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 then reviewed. Materials of thin film resistor (for thermal ink jet) and piezoelectric ceramic (for piezoelectric ink jet) are also reviewed. The course concludes with insights into the potential material interactions between the more complex jetting fluids and the printhead structures in several emerging applications such as bio-printing and printed electronics.

Benefits

This course enables attendees 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 other charged with development or manufacture of ink jet printing systems.

Hue Le is an ink jet printing technologies consultant at Le Technologies Inc. From 1997 to 2011, he formed and worked at Pico-Jet Inc., Hillsboro, OR, which designed and manufactured fluid jetting devices and systems for industrial printing applications. Prior to PicoJet, Hue was director of technology development for Tektronix, Inc.'s Printing and Imaging Division. He has more than 32 years of experience in developing and commercializing ink jet printing systems and holds 21 US patents. Le received a BS in chemistry, University of Iowa (1979) and MS in chemistry, New Mexico State University (1981).

SC04-S1: Introduction to Toner Technology

Sunday 8:00 – 10:00 am (2 hours)
Instructor: Jodi Lynn Walsh, Lexmark International, Inc.

This course is a general introduction to toner formulation. Formulation disciplines, material selection and function, and particle architecture implications are summarized. Various toner design criteria and performance requirements in multiple embodiments are also discussed. Analytical and measurement techniques are surveyed including size, shape, charge, flow, and rheological attributes. A glossary and bibliography for future reference are provided.

Benefits

This course enables an attendee to:

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

Intended Audience: anyone seeking an introduction to electrophotography, electrophotographic printing, supplies technology, or related development activities; an interest in toner or carrier is helpful, but no working knowledge of electrophotography is presumed nor required.

Jodi Walsh is the CPT Engineering Manager in the Imaging Solution and Services Division of Lexmark International. She has been involved broadly across the toner business for 19 years in toner manufacturing, support, and CPT Engineering. Walsh began her career as a formulator under the tutelage of George Marshall and was a technical leader in Lexmark's first color milled toner products and has published multiple toner related patents. She received her PhD in physical organic chemistry from Northwestern University (1994).

SUNDAY SHORT COURSES			
Digital Printing Technology	**3D Printing/ Digital Fabrication Technology**	**Ink Jet Technology**	**Toner/EP Technology**
SC01: Recent Advances in Nanotechnology	SC02: Intro. to Digital Fabrication: Methods, Materials, and Applications	SC03: Fabrication Materials & Processes of Ink Jet Printheads	SC04: Intro. to Toner Technology
SC05: Role of Inkjet in Commercial and Industrial Printing Applications	SC06: Intro. to 3D Ink Jet Printing	SC07: Surface Ink Interactions and Surface Characterization	SC08: Liquid Toner Printing: Technology and Applications
SC09: Paper Recycling and Ecolabels, Deinking, and Deinkability	SC10: Intro. to 3D Printing of Metals	SC11: Colorants for Inkjet Applications	SC12: Toner Materials—Engineering and Print Relationships
SC13: Digital Packaging	SC14: Direct 3D Fabrication and Ink Printing, Industrial Applications, and Challenges	SC15: Fluid Dynamics and Acoustics of Ink Jet Printing	SC16: Fusing Physics and Technologies
MONDAY SHORT COURSE: SC17: Security Printing Opportunities in Digital Printing and Fabrication			

SC05-S2: Role of Inkjet in Commercial and Industrial Printing Applications

Sunday 10:15 am – 12:15 pm (2 hours)
Instructor: Ronald Askeland, Hewlett Packard Company

Printing products from HP, Canon, Epson, FujiFilm, Xaar, Kyocera, Ricoh, Memjet, and Kodak are scrutinized and compared. The suitability of inkjet print systems for markets beyond home and office is evaluated and contrasted with electrophotographic, offset, flexo, screen and rotogravure printing in those markets. Thermal, piezo, and continuous inkjet printhead performance parameters and ink/media interactions are examined for applications in large format, publishing, direct mail, photographic, package and textile printing. UV, solvent, aqueous, latex and textile inkjet inks are described. Recent product introductions and future trends in commercial/industrial printing are discussed.

Benefits

This course enables an attendee to:

- Compare the pros and cons of electrophotographic, inkjet, and analog printing technologies in commercial/industrial applications.
- Describe key differences in piezo, continuous, and thermal inkjet printhead performance characteristics.
- Understand the differences between UV, solvent, aqueous, latex, and textile inks.
- Be aware of future directions in digital printing beyond home and office.

Intended Audience: those somewhat familiar with inkjet printing technology who would like a better understanding of inkjet's role in the analog to digital conversion process.

Ronald Askeland is a system architect in the large format production printer division of Hewlett Packard in Barcelona, Spain. He has 30 years of experience in inkjet technology and has been awarded more than 60 US patents on inkjet inks and printing systems. Askeland received his PhD in analytical chemistry from Colorado State University and worked for HP in San Diego, CA from 1984-2011. He is the author of Inkjet Print Engines in The Handbook of Digtial Imaging, *edited by Michael Kriss.*

SC06-S2: Introduction to 3D Ink Jet Printing

Sunday 10:15 am – 12:15 pm (2 hours)
Instructor: Sascha de Peña, Hewlett-Packard Company

3D printing or additive manufacturing technologies in general, is an expected future growth area, with a wide variety of different technologies available. Some of the fundamental technologies have been around for a while but the latest enhancements in equipment, performance, and materials are now making them a compelling alternative for a diverse range of applications, some of them unique. Also the emergence of low cost 3D printers is contributing to the popularity of the subject. This course provides an overview of the existing 3D printing technologies, materials, their fundamentals, current performance, relative strengths and weaknesses. An overview of the 3D printing overall ecosystem,

market, players, applications, software, trends, and news is included.

Benefits

This course enables an attendee to:

- Get up to speed on 3D printing (additive manufacturing) fundamentals in a short time.
- Have a clear view of different existing approaches to create 3D parts by means of additive manufacturing.
- Understand the fundamentals of the underlying technologies and the materials used to work with each of those.
- Learn the pros and cons of each technology and the challenges ahead. Also, an overview of some public research projects being conducted in 3D around the world.
- Appreciate a broad view of the key players in the market, the verticals being addressed, a rough idea of the market potential, and thoughts on how the industry may evolve and the barriers to mass adoption.

Intended Audience: anyone interested in getting up to date in regards to 3D printing, with none or little previous exposure to it (this is where the gain/time is maximized).

Sascha de Peña is a physicist with an MBA, ESADE, and a PhD in plasma physics conducting research at the Max-Planck- Institute for Plasma Physics (IPP) concerned with the investigation of the physical basis of a fusion power plant. Currently, he is master technologist and R&D Chief Engineer at HP's Printing and Personal Systems Group, responsible for the technical direction of several large format printers and in charge of the evaluation and development of technologies for rapid prototyping.

SC07-S2: Surface Ink Interactions and Surface Characterization

Sunday 10:15 am – 12:15 pm (2 hours)
Instructor: Kock-Yee Law, Research and Innovative Solutions

Fundamental understanding of how inks wet, spread, de-wet, and pin on a print surface is important not only to the quality of the print output. It is even more crucial to modern printed (or flexible) electronics manufacturing, where print resolution and device functional performance are paramount. This short course starts with a tutorial on surface characterization and wetting fundamentals. Discussions include the understanding of measurement tools for surfaces and coatings, wetting dynamics, and the meanings of these measurements. The importance of understanding and controlling ink wetting, spreading and evaporation in digital manufacturing is illustrated. The mechanism for the formation of the "coffee ring" stain is included and countermeasures are discussed.

Benefits

This course enables an attendee to:

- Learn how surfaces are usually characterized by contact angle measurements, and how to interpret them.
- Understand how to upgrade their measurement tools and procedures at work.
- Expand their knowledge in ink-surface interactions and be ready for future challenges.

Intended Audience: managers and executives from both industry and academia should find it beneficial by learning the importance of fundamental to problem solving in general. Surface scientists/engineers and researchers in digital fabrication will benefit from the overview of the state-of-the-art wetting fundamentals and concepts as well as its applications in digital printing.

For bio, see SC01-S1.

SC08-S2: Liquid Toner Printing: Technology and Applications

Sunday 10:15 am – 12:15 pm (2 hours)
Instructor: George Gibson, PARC, Inc., A Xerox Company

Liquid toner technologies have long been held as versatile methods for imaging in a variety of applications. Known for high image quality, especially high-quality color, liquid toners are undergoing a renaissance. Important applications include not only document printing, but a number of industrial printing, display, and fabrication applications. In spite of demonstrated strength, liquid toners are employed in a minority of printing systems today. HP, the dominant provider in the technology continues to innovate. In addition, new offerings from several large and sophisticated firms (Océ and Xeikon) have served to create new interest and energy into the technology. This course explores how the fundamental strengths of this technology have led to this current state and project where liquid toner will continue to be a vibrant force. The course covers the variety of liquid toner processes that are and have been used, including the strengths and limitations of each, and the major application areas in which these techniques are employed. The course includes an analysis of improvements of liquid toner systems found in recent technical literature and patents. Participants will receive a copy of several chapters of my forthcoming book length treatment of the technology.

Benefits

This course enables an 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.
- Identify the major market applications where liquid toners are used today.
- Have a vision of where liquid toner technologies are fundamentally advantaged.
- Learn about recent innovations in liquid toner technology.

Intended Audience: technical professionals who want to become more knowledgeable about liquid toner printing technology.

George A. Gibson serves as Principal, Strategy, Business Development and Operations for PARC, Inc. a Xerox company. He has led research, development, and manufacturing organizations involved in non-impact printing for more than 30 years. Originally trained as a chemist, he did his undergraduate and graduate degrees at Binghamton University. He also holds an MBA from the University of Rochester's Simon Graduate School of Business. Gibson has 52 US patents and has written more than 20 published papers in imaging and colloid science and the management of research and development. He is a frequent lecturer in imaging technology, R&D productivity, portfolio management, and technology valuation.

SC09-S3: Paper Recycling and Ecolabels, Deinking, and Deinkability

Sunday 1:30 – 3:30 pm (2 hours)
Instructor: Axel Fischer, INGEDE e.V.

The paper recycling process has been developed to unlock the "urban forest"—the piles of read newspapers and magazines—as an inexpensive source for paper fibers. At the same time, the recycling cycle has proven to be an essential component of sustainable handling of resources. As a result, all members of the paper supply chain contribute to its conservation.

Digital printing has a number of environmental benefits. However, some print processes can result in severe problems in paper recycling. This short course will—supported by videos and other descriptive material—explain deinking in the industrial paper recycling process, how this process is simulated and evaluated in the lab, and how it is challenged by different printed products. A discussion of present and future European ecolabels and significant related tax regulations for printed products is included.

Benefits

This course enables an attendee to:

- Identify different printed products and printing technologies.
- Understand the environmental impact of printed products after leaving the shop.
- Understand the paper recycling process, and the importance and mechanism of deinking as the key of this process.
- Understand what European and US paper recycling have in common and how they differ.
- Learn about the different challenges of various printing processes.
- Comprehend the principles of deinking in the laboratory and how it relates to industrial practice.
- Learn how good deinkability can be achieved for different types of inks and printing processes.

Intended Audience: anyone interested in environmental issues and the impact related to printed products, such as product development engineers, product stewards, sales engineers, environmental regulatory managers, field application engineers, ink developers, and others.

Axel Fischer studied chemistry at Munich Technical University. Since 1994, he has been responsible for public relations for INGEDE, the International Association of the Deinking Industry. He represents INGEDE at international events and working groups dealing with recyclability, with digital printing technologies, and sustainability in the paper chain. He chairs the International Round Table on the Deinkability of Digital Prints and consults printers in Europe on the recyclability of printed products. His teaching experience includes composing and presenting a science television show for three years.

SC10-S3: Introduction to 3D Printing of Metals

Sunday 1:30 – 3:30 pm (2 hours)
Instructor: Jason Jones, Hybrid Manufacturing Technologies

3D printing, also known as additive manufacturing, has recently emerged from niche engineering and hobbyist use, to be a mainstream strategic technology across a broad range of applications. Two recent developments have helped catalyze its recent growth: low cost polymer printers and high-end metal printers. The internet is saturated with information about low-cost printers; however, finding reliable information about metal printing is more difficult. Furthermore, the deposition of metal using digital printing techniques has not yet received significant attention.

This course provides insight into the existing techniques for producing metal parts directly and

indirectly using 3D printing technologies, including an assessment of their relative strengths, weaknesses, and costs. Additionally, the fundamentals of material preparation, how oxidation is avoided, and post processing methods will be addressed. Key market players, applications (including aerospace, dental, medical, and printed electronics) and standards activities are identified. Perhaps most importantly, trends for future growth, including opportunities for digital printing are highlighted.

Benefits

This course enables an attendee to:

- Understand the state-of-the-art in metal additive manufacturing processes.
- Become conversant with the fundamentals and issues of additive metal approaches.
- Appropriately match techniques (based on their pros and cons) with a variety of applications.
- Gain a sense of the direction of future development and potential for this technology and the future opportunities for digital printing.

Intended Audience: anyone interested in gaining early-intermediate exposure and understanding of the 3D printing of metals. Also those who want a frame of reference for comparing larger scale metal printing practices with conventional digital fabrication practices (for example comparing the production of aerospace parts with printing conductive tracks). There are no pre-requisites for this course.

Jason Jones is co-founder and CEO of Hybrid Manufacturing Technologies, a 3D printing start-up equipping CNC machines for additive manufacturing. Jones has a PhD in 3D printing from the University of Warwick and has led millions of dollars of AM research and authored numerous publications and patents during the last decade. He has investigated 3D printing/digital fabrication techniques for multi-material functional parts and hybrid processing approaches for metals. He is a founding member of the ASTM F42 committee for AM and has led the development of several standards (including ISO/ASTM 52921). He serves as an advisor for SME's Rapid Technologies & Additive Manufacturing Community. This short course has been prepared with associate professor Greg Gibbons of the University of Warwick, a 20-year veteran in the field of Additive Manufacturing.

SC11-S3: Colorants for Inkjet Applications

Sunday 1:30 – 3:30 pm (2 hours)
Instructor: Alex Shakhnovich, Cabot Corporation

This course is an introduction to available colorant choices for office and commercial inkjet printing with focus on three areas – colorants for inkjet applications, dispersion methods, and failure modes in inks and during printing. The first part addresses the choices of color pigments available to the industry. Specific attention is paid to yellow pigments, as the most challenging components of CMY color triad. Using dyes as complements to pigments is also covered. In the second part of the course, two principal dispersion methods – surface modification and using polymeric dispersants are covered. Advantages and drawbacks of both approaches are discussed in-depth. Finally, we describe colorants failure modes in inks during storage and during the printing process. The fastness properties of color pigments is also addressed.

Benefits

This course enables an attendee to:

- Intelligently choose the colorants for inkjet inks, understanding differences in properties and tradeoffs.
- Understand what questions should be addressed when selecting colorant(s) for a new application or a retrofit.
- Become familiar with major technologies used for preparing inkjet dispersions.

Intended Audience: technical and commercial people, who would like to get some fundamental understanding of pigment chemistry and selection of pigment dispersions for inkjet printing.

Alex Shakhnovich is a Research Fellow at Cabot Corporation in Billerica, Massachusetts. He has more than 40 years of experience in chemistry and application of colorants for plastics, textile, and inkjet. His specific focus at Cabot is preparation of surface-treated organic pigments. He has been awarded 10 US patents in inkjet area. Shakhnovich received his MS in chemistry from Moscow State University and his PhD in heterocyclic chemistry (1979) from Institute of Dyes and Intermediates (Moscow, Russia). Shakhnovich is a co-author of the chapter Pigments for InkJet Applications edited by World Scientific Publishing Co. ©2010. His research interests include synthesis, surface modification, and application of organic colorants.

SC12-S3: Toner Materials—Engineering and Print Relationships

Sunday 1:30- 3:30 pm (2 hours)
Instructor: Dinesh Tyagi, Lexmark International, Inc.

Toners play a very critical role in establishing the value of an electrophotographic print. Since toner comes in physical contact with all critical steps of an EP cycle, its properties not only affect the final printed document but also the life time of components used in other sub-systems. Thus, it is not a surprise that the composition of toner is often determined by the requirements of the finished print as well as the technology selected in other steps of electrophotography. A toner polymers selection is also dictated by the toner manufacturing process used to produce them. The course describes how the toner polymers are selected for both Melt Pulverized Toners (MPT) and Chemically Prepared Toners (CPT). Effect of toner additives, such as, pigments, surface treatment etc. on fusing and other toner properties are also explained.

The underlying polymer architecture and viscoelasticity concepts that govern toner binders are described and briefly discussed. Polymer models described in this course are equally applicable to polymeric substances used in other parts of the fuser, such as, elastomers and release fluids. Since the toner composition and fusing performance are intricately intertwined, the course describes the influence of toner and the fusing technology employed on the print physical and image permanence. During the course, the selection process for most toner components are described including how these requirements are being continuously guided by environmental, governmental and health regulations. The course will also discuss new developments that are taking place in toners, including, low energy requirements, "green" toners that comprise bio-resins and toner/print recyclability.

Benefits

This course enables an attendee to:

- Gain insight into toner component selection and their manufacturing processes along with the impact of each on toner properties, image fixing and, print physicals of a print.
- Understand the polymeric concepts that influence fusing and various considerations necessary in toner formulations.
- Comprehend viscoelastic behavior of toners and polymers. This knowledge can then be used to develop understanding of gloss control and other image requirements.
- Toner components selection criteria would be discussed along with the limitations imposed by toner manufacturing technologies.
- New advances in toners and along with new regulations from various agencies that may impact toners will be described.

Intended Audience: all individuals who are directly or indirectly involved in toner formulation development efforts in order to meet wide range of image requirements as well as the limitations imposed by each toner manufacturing method. The course is particularly useful for engineers and scientists who wish to gain insight into controlling image permanence, gloss and print physicals via toner component selection and design. A basic understanding of the electrophotographic process will be assumed; but many underlying polymer concepts would be described in the course.

Dinesh Tyagi received his PhD from Virginia Tech (1985). He then joined Eastman Kodak Company as a Research Scientist where he specialized in the field of digital printing and polymer research. He was inducted into Kodak's Distinguished Inventors Gallery in 1994. In 1999, he joined NexPress Solutions, which was later acquired back by Kodak. Tyagi recently joined Lexmark International where he continues to work in the area of toners and electrophotography as he has done through most of his professional career. He has been granted more than 300 patents worldwide. In 2011, he was awarded the Chester F. Carlson Award for his innovations and broad contributions to electrophotographic toner technology. In 2014, Tyagi received the Robert F. Reed Technology Medal in recognition for his involvement in graphic communications industry.

SC13-S4: Digital Packaging

Sunday 3:45 – 5:45 pm (2 hours)
Instructor: George Gibson, PARC, Inc., a Xerox Company

The role of the package is becoming increasingly complex and valuable. Packages are no longer just "the-thing-you-put-the-thing-in" but are becoming an active part in the pre- and post-sale experience. Packaging has been shown to play a significant role in improving consumer experience, establishing and protecting brand image, and product protection. Fulfilling these roles has led to the demand for new package functionality with some packages even beginning to show up as citizens in the internet of things (some even employing printed electronic componentry). Packages are becoming part of the overall customer value creation ecosystem. Digital packaging particularly is enabling brand owners to build stronger relationships with their customers, increasing satisfaction and indeed loyalty from increasingly demanding shoppers.

The benefits of digital printing and fabrication techniques include the ability to economically produce short runs, targeted versioning and even

personalization using simplified workflows and in record time—all with a superior sustainability profile. Further, the integration with (for instance) the previously cited printed electronics allows entre into packaging with entirely novel functionality.

Packaging is an incredibly diverse domain encompassing metal and glass containers, corrugated, folding cartons, and flexible packaging including labels on a wide variety of substrates. Selecting the best digital technique requires a detailed understanding of the printing, the substrates, and the end use requirements. Examining the available digital techniques, and the application requirements, we examine a number of successful implementations and derive heuristics to guide applications. We explore where additional technological improvements will have the greatest leverage.

Benefits

This course enables an attendee to:

- Understand the changing role and requirements placed on packaging in this rapidly changing domain.
- Understand the forces driving adoption of digital print in various package printing applications including the provision of functionality inaccessible to conventional approaches and how these can enable market growth.
- Understand the applications and requirements for package printing in label, folding carton, corrugated packaging, and flexible packaging.
- Map the technology characteristic onto the market requirements identifying the relative strengths, weaknesses, opportunities, and threats of each technology in the context of packaging markets.

Intended Audience: technical professionals who want to become more knowledgeable about how digital printing is likely to fit into the package printing markets.

For bio, see SC08-S2.

SC14-S4: Direct 3D Fabrication and Ink Printing, Industrial Applications, and Challenges

Sunday 3:45 – 5:45 pm (2 hours)
Instructor: Kock-Yee Law, Research and Innovative Solutions

As modern manufacturing technology is evolving, the trend is to be digital, on demand and green. Of course, cost and performance will always be factors so do risk and benefit when choosing a manufacturing technology. This short course starts with a review on the landscape and trend of recent digital manufacturing technologies. Traditional 3D printing processes, such as stereolithography, selective sintering, selective melting, direct ink printing, hot melting printing and inkjet printing is also covered. This is followed with another overview covering the application of 2D ink printing technologies for the manufacturing of consumable electronics and printed flexible electronic devices. The technical challenges to implement these technologies aree discussed.

Benefits

This course enables an attendee to:

- Become familiar with the field of nanotechnology, and benefit from seeing the entire landscape as well as the advanced research and social impact.
- Broaden their knowledge base especially for those engaging in research in a given nano area.
- Be inspired lead to the creation of cross discipline research areas in the future.
- Learn about the latest advances in key research areas using nanotechnology.

Intended Audience: scientists, engineers, managers, and executives from both industry and academia will find it beneficial.

For bio, see SC01-S1.

SC15-S4: Fluid Dynamics and Acoustics of Ink Jet Printing

Sunday 3:45 – 5:45 pm (2 hours)
Instructor: J. Frits Dijksman, University of Twente

Inkjet printing is a process of depositing on demand droplets with a well-defined volume on a precisely given location on a substrate. The course is restricted to piezo driven print heads. A piezo driven print head is a set of closely packed acoustic cavities, each cavity partly covered with a piezoelectric actuator, of which the fluid dynamical and acoustical characteristics will be presented in the time and frequency domain. The process starts with generating electric pulses to selected piezoelectric actuators. In the connected cavities pressure waves are introduced. At the nozzles these pressure waves are changed into velocity waves. In case such a velocity wave is sufficiently intense, droplet(s) are formed.

The process ends with droplet landing, being a highly dynamic phenomenon, with its own timing characteristics. The aim of this course is to couple the characteristics of droplet formation and landing to the acoustics of the fluidics of the print head behind the nozzle all the way up into the ink supply. Special attention will be paid to fluidic cross-talk in multi-nozzle print heads and the jetting of viscoelastic inks.

Benefits

This course enables an attendee to understand the interactions between the acoustics of the fluidics of the print head and the characteristics of piezo inkjet droplet formation, landing, spreading, and permeation.

Intended Audience: engineers and scientists interested in piezo driven print heads, students in the area of print head physics, engineers and scientists working with biomedical applications of inkjet technology.

Frits Dijksman is professor in the field of innovative biomedical applications of inkjet technology at the University of Twente, the Netherlands. He has worked with Philips Research for more than 30 years and his main area of interest has been inkjet technology for consumer and non-consumer applications, such as PolyLED display manufacturing and the printing of biomolecules.

SC16-S4: Fusing Physics and Technologies

Sunday 3:45 – 5:45 pm (2 hours)
Instructor: Dinesh Tyagi, Lexmark International, Inc.

In spite of the numerous technological advances that are have been made in the area of toners, development and rendering schemes, the final image quality is ultimately determined by the customer holding the final print. From image gloss to color reproduction and including print physical performance, the final properties are directly dictated by the fusing step.

Most conventional electrophotographic printing systems require a fusing sub-system that takes the discrete toner particles and both fuses (coalesces) them together and fixes them to the media. This process is required to produce an attractive, durable image that is bonded tightly to the substrate. This course reviews the fundamental functions of fusing and details past and current fusing technology trends in the electrophotographic industry. The physics of each fusing technology is discussed, with a specific focus on each technology's strengths and weaknesses. Physics and mathematical models of thermal fusing are described along with the critical parameters in fusing steps. In the later part of the course, the most common fusing technologies are discussed, covering the critical parameters and failure modes that govern each fusing methodology. The course also covers the scientific and engineering challenges that are faced during both the technology and product-development cycles of a fuser. Common tests for image permanence are discussed along with the available options to enhance print physical performance.

Benefits

This course enables an attendee to:

- Identify and comprehend advantages and disadvantages of different fusing technologies that have been developed and used throughout the industry.
- Analyze the critical parameters that define the fusing process and latitude for common fusing technologies.
- Determine the critical failure modes, and the critical parameters that govern them, for conventional fusers.
- Measure image permanence and discuss available steps for improving fusing quality of images on various substrates.

Intended Audience: scientists, engineers and technicians who are directly or indirectly involved in the selection, analysis, and evaluation of the numerous fusing technologies used in today's electrophotographic engines. The course is also beneficial to those who are working in other areas of EP system, so they have a better understanding of fusing process and materials requirements. A basic understanding of the electrophotographic process will be assumed; familiarity with the basics of heat transfer, and mechanics will be beneficial, but is not required.

For bio, see SC12-S3.

Monday September 28, 2015

SC17-M: Security Printing Opportunities in Digital Printing and Fabrication

Monday 2:00 – 4:00 pm (2 hours)
Instructor: Alan Hodgson, Alan Hodgson Consulting Ltd.

This short course highlights the opportunities for printing and fabrication in security printing. There are specific opportunities in the technologies of physics, chemistry, and material science and an ongoing market for new hardware and software applications for print inspection and verification. This year the course content has been refreshed (or do we say: includes with print-on-paper opportunities for desktop inkjet systems).

After a brief introduction to this market sector and the technical characteristics of the solutions, the course covers 3 main sections.

1. The security printing ecosystem: including relevant materials, printing processes, electronics, and electro-optic hardware established in this sector. This section covers existing applications and current opportunities.
2. The threat from new digital printing technolo-

gies: security features that have been used for years could become compromised by digital printing. These threats are also opportunities for new printed and fabricated security features.
3. Emerging opportunities for new features: printed electronics, mobile imaging and 3D printing are starting to find their way into this sector.

The course features a number of case studies addressing the relative attributes of toner and inkjet printing in this space and the potential impact of page wide inkjet. Trial examples of printed electronics in security printing are also described.

Benefits

This course enables an attendee to:
- Understand the fundamentals driving security printing opportunities.
- Identify opportunities for materials, print engines and electro-optic hardware.
- Gain an overview of how technologies such as printed electronics and mobile imaging can be used in the security print market sector.

Intended Audience: material scientists, print professionals and engineers who are looking for applications of their technology in the field of security printing. Join us to explore the opportunities that exist in security printing.

Alan Hodgson has 30 years' experience in printed hard copy and a background in photography and image science. He previously managed R&D and technical services groups active in inkjet application development. He spent 7 years at 3M, specializing in print solutions for high security documents such as passports and identity cards . He recently returned to his consultancy business, working on printing consultancy projects that include security applications. Hodgson is active in printed electronics, both as a practitioner and chair of IEC TC119. He has a BSc in colorant chemistry and a PhD in instrumentation, both from the University of Manchester. He has served as session chair, short course instructor, and presenter at a number of IS&T conferences such as NIP, DF, Archiving, and ICIS. He is past President of IS&T.

Hotel and Travel Information

Portland Marriott Downtown Waterfront Hotel

1401 SW Naito Parkway • Portland, OR 97201
+1-503-226-7600

Rate: Single/Double $179 plus 14.5% tax

Rate availability: The discounted rate is available for 3 days prior to and 3 days after the conference dates, based on availability. Early reservations are assigned on a priority basis to conference attendees provided they are received by September 5, 2015. To guarantee a room, a credit card number or deposit equal to one night's housing must accompany the reservation request.

Reservations Deadline: September 5, 2015

Online reservation link: https://resweb.passkey.com/go/NIP31Portland
Phone reservations: +1-877-901-6632 / Reference: NIP31/DF2015.

Check in/out: 3:00 pm/noon

Cancellation Policy: less than 24 hours notice incurs a fee of one (1) room night + tax.

Travel Details

Portland International Airport (PDX) is 9 miles from the hotel. For more information, visit www.flypdx.com/PDX.

Getting to Hotel from Airport (7 miles)

Via Train
- Take the MAX Light Rail Red Line toward City Center & Beaverton to Morrison/SW 3rd Ave. It is approximately a ½ mile walk to the hotel. One-way fare is $2.50. More information at airport-portland.com/Transportation.cfm.

Via Taxi
- Charge is approximately $40 to the hotel, depending on time of day and traffic.

Via Blue Star Shuttle
- One-way fare is $14. Reservations can be made at www.bluestarbus.com/airport-shuttle.php.

About Portland

See details, page 19.

Technical and Social Program

All papers are oral unless marked as focal or interactive. Program is subject to change.

See page 1 for details on Sunday's Short Course Program, which runs from 8:00 AM to 5:45 PM and offers 16 classes on a wide range of topics. There is also one course on Monday.

SPECIAL EVENT: WELCOME RECEPTION

Kick off the conference by meeting friends and colleagues Sunday evening.

Sunday, September 27th
5:45 – 7:00 PM
Portland Marriott Downtown Waterfront Hotel

SPECIAL EVENT: STUDENT AND YOUNG PROFESSIONALS ARCADE NIGHT

In an ongoing effort to engage our student and young professional attendees in having a meaningful experience while attending the conference, we have a fun evening event planned. More information sent closer to the event.

Monday, September 28th
beginning at 6:30 PM
Details on ticket

Monday September 28, 2015

ALL TRACKS

OPENING CEREMONY AND KEYNOTE
9:00 – 10:00 AM
The Third Digital Revolution, *Neil Gershenfeld, Massachusettes Institute of Technology (USA)*

SURFACE MANUFACTURING ROUNDTABLE
4:30 – 5:50 PM
See details, page 13.

DIGITAL PRINTING TECHNOLOGIES TRACK

INKJET-BASED PROCESSES
Sponsored by Xaar plc

10:10 AM – 5:50 PM

A Simple Model for DoD Inkjet Frequency Response, *Stephen D. Hoath, University of Cambridge (UK)*

Ink-Particle Simulation for Continuous Inkjet Type Printer, *Masato Ikegawa, Masanori Ishikawa, and Eiji Ishii, Hitachi Ltd.; Nobuhiro Harada and Tsuneaki Takagishi, Hitachi Industrial Equipment Systems Co., Ltd. (Japan)*

Jetting Frequency and Evaporation Effects on the Measurement Accuracy of Inkjet Droplet Amount (JIST-first Paper), *Kye-Si Kwon, Dahai Zhang, and Hyun-Seok Ko, Soonchunhyang University (Korea)*

Aerodynamic Effects in Industrial Inkjet Printing (JIST-first Paper), *Maria Cristina Rodriguez-Rivero[1], José Rafael Castrejón-Pita[2], and Ian Hutchings[1]; [1]University of Cambridge and [2]Queen Mary University (UK)*

3D Inkjet Printing of Optics (Focal), *Joris Biskop and Ricardo Blomaard, LUXeXceL Group BV (the Netherlands)*

InkJet Printing System for High Print Quality on Offset Coated Paper, *Shinta Moriya, Yoshinari Suzuki, Shigeru Kinpara, and Yoshihisa Ohta, Ricoh Company, Ltd. (Japan)*

MONDAY KEYNOTE

The Third Digital Revolution
Prof. Neil Gershenfeld
Director, MIT Center for Bits and Atoms

Analog telephone calls degraded with distance; digitizing communications allowed errors to be detected and corrected, leading to the Internet. Analog computations degraded with time; digitizing computing again allowed errors to be detected and corrected, leading to microprocessors and PCs. Manufacturing today remains analog; although the designs are digital, the processes are not. Gershenfeld will present emerging research on digitizing fabrication by coding the construction of functional materials, and explore its implications for programming the physical world.

Effects of Ink-Paper Interaction and System Parameters on Drying Quality in High Speed Color Ink Jet with Infrared Ray Heater, *Satoshi Hasebe, Tomozumi Uesaka, Kumiko Tanaka, Masahiko Sekimoto, Motoharu Nakao, Toshinobu Hamazaki, and Eizo Kurihara, Fuji Xerox Co., Ltd. (Japan)*

Functional Coating Developments for the Digital Manufacturing Age (Interactive), *Patrick Le Galudec and Daniel Loosli, Sihl AG (Switzerland)*

Something for Nothing- Developing MEMS Silicon for a Vertically Integrated Market Leading Business-The Example of HP Thermal Inkjet, *Jim Przybyla, Hewlett Packard Co. (USA)*

Study of Paper Deformation Mechanism in Color Inkjet Printing Process with Infrared Radiation Heater, *Motoharu Nakao, Satoshi Hasebe, Ryosuke Takahashi, and Takashi Ogino, Fuji Xerox Co., Ltd. (Japan)*

Real-Time Back Pressure-Modulation of Dot Gain in Inkjet Printing, *Anurag Kumra, Nikhil Bajaj, J. William Boley, and George T.-C. Chiu, Purdue University (USA)*

Intense Pulsed Light Sintering and Parameter Adaption for Various Inkjet Printed Silver Electrodes, *Dana Weise[1], Christoph Sternkiker[1], and Reinhard R. Baumann[1,2]; [1]Technische Universität Chemnitz and [2]Fraunhofer Institute for Electronic Nano Systems ENAS (Germany)*

Recent Developments in Moving Nozzle Inkjet Printhead Technology, *Peter Brown, David Smith, James Lazarus, and Andrew Polijanczuk, The Technology Partnership (UK)*

Polyaniline Nanofibers for Security Printing Applications, *Jeevan Meruga, Jacob Petersen, Rohit Dulal, William Cross, Grant Crawford, and Jon Kellar, South Dakota School of Mines and Technology (USA)*

Development of Inkjet Supply for Offset Paper, *Yuuki Yokohama, Hiroshi Gotoh, Mariko Kojima, Tsutomu Maekawa, and Michihiko Namba, Ricoh Company, Ltd. (Japan)*

MATERIALS, METHODS AND PERFORMANCE TRACK

PHYSICS AND CHEMISTRY OF MATERIALS

10:10 – 11:10 AM

Computation of Break-up Time in Inkjet Printing from Bulk Rheological Data and Filament Stretching Experiments, *Maik Müller[1], Gustaf Mårtensson[2], Ingo Reinhold[1], Tim Wickens[3], and Werner Zapka[1]; [1]XaarJet AB (Sweden), [2]Mycronic AB (Sweden), and [3]Xaar plc (UK)*

Measurement Technique for Electrostatic Charge on Single Toner Particle with MEMS-based Actuated Tweezers, *Daichi Yamaguchi, Shuusuke Someno, and Masaya Hamaguchi, Ricoh Company, Ltd. (Japan)*

Complete Incorporation of Wax in Polyester CPT Using Polyester-Encapsulated Wax Emulsion, *Machiko Ie, Tomohide Yoshida, Shoichi Murata, and Eiji Shirai, Kao Corporation (Japan)*

METROLOGY TOOLS FOR DIGITAL PRINTING PROCESSES

11:50 AM – 1:10 PM

The Colour of Glass, *Susanne Klein[1], Michael P. Avery[2], Robert M. Richardson[3], Paul Bartlett[3], and Steven Simske[4]; [1]Hewlett-Packard Labs (UK), [2]Bristol Centre for Nanomaterials (UK), [3]University of Bristol (UK), and [4]Hewlett-Packard Labs (USA)*

Measurement Method of Toner Mass Distribution by Reflectance Using Multiple Exposure (Focal), *Takuroh Sone, Yumiko Kishi, and Makoto Hino, Ricoh Company, Ltd. (Japan)*

Study on Atomistic Behavior of Macromolecules by Molecular Dynamics Simulation and its Enlargement in Scale, *Tomohiro Seko, Yuki Sasaki, Kazuhiko Yanagida, Kazuki Inami, and Nobuyuki Nakayama, Fuji Xerox Co., Ltd. (Japan)*

Identification Technology of Paper (Interactive), *Takahisa Nakano, Nobuki Nemoto, and Takeo Miki, Toshiba Corporation (Japan)*

Atomic Force Microscopy Characterization of Printing Dots (Interactive), *Maria J. Cadena, Ronald Reifenberger, Jan P. Allebach, and Arvind Raman, Purdue University (USA)*

PERFORMANCE OF DIGITAL PRINT PRODUCTS

2:30 – 6:10 PM

Mitigation of Pollution-Induced Deterioration of Digital Prints through the Use of Enclosures, *Daniel Burge and Andrew Lerwill, Image Permanence Institute (USA)*

Investigating the Validity of Microfading Spectroscopy to Predict Photochemically Induced Color Change at Lower Light Levels, *Andrew Lerwill[1,2], Christel Pesme[1], Vincent Beltran[1], and James Druzik[1]; [1]Getty Conservation Institute and [2]Image Permanence Institute (USA)*

Printed Electronics Standard Measurement Method for Inkjet Drop Speed, *Stephen D. Hoath, University of Cambridge (UK)*

Evaluation of the Image Permanence of Digital Colour Photographic Prints based on Colour Difference, *Yoshi Shibahara[1], Evert Groen[2], and Nobuhiko Uchino[1]; [1]Fujifilm Corporation (Japan) and [2]Fujifilm Manufacturing Europe B.V. (the Netherlands)*

Relationship between Chinese Text (Kanji) Quality and Card Printing Technology, *Mark B. Mizen, HID Global, and Ming-Kai Tse, Quality Engineering Associates (QEA), Inc. (USA)*

Fire Safety and Inkjet Printed Wallcovering Materials (Interactive), *Bruno Fouquet, Diatechnologies SAS (France), and Patrick Le Galudec, Sihl AG (Switzerland)*

Spot Color Matching for Digital Package Prototyping Using UV Ink-Jet Printer, *Yu Ju Wu, Appalachian State University (USA), and Reem El Asaleh, Ryerson University (Canada)*

Belt Fuser Torque: Modeling Mechanism Drag as Parametric Damping and Corroborating Measurement with EHL Theory, *Benjamin Johnson, David Battat, and Jean-Marie Massie, Lexmark International, Inc. (USA)*

Quantifying Print Quality for Practice, *Elisa H. Barney Smith, Boise State University, and Eric Maggard, Scott Line, and Mark Shaw, Hewlett-Packard Co. (USA)*

Predictive Accelerated Aging Tests for Evaluating the Permanence of Modern Silver-Halide Color (Chromogenic) Photographic Prints, *Henry Wilhelm, Barbara C. Stahl, and Carol Brower Wilhelm, Wilhelm Imaging Research, Inc. (USA)*

DIGITAL FABRICATION AND 3D PRINTING TRACK

DIGITAL PRINTING AND FABRICATION PRINCIPLES AND PROCESSES

10:10 AM – 12:10 PM

Paper Wrinkle in Printing Devices, *David Battat, Lexmark International, Inc. (USA)*

Electrophotographic Ghosting Detection and Evaluation, *Xiaochen Jing[1], Steve Astling[2], Renee Jessome[2], Eric Maggard[2], Terry Nelson[2], Mark Shaw[2], and Jan P. Allebach[1]; [1]Purdue University and [2]Hewlett-Packard Co. (USA)*

Modulated Extrusion for Textured 3D Printing, *Paul O'Dowd, Stephen Hoskins, and Adrian Geisow, University of the West of England (UK)*

Biopolymers for 3D Printed Bone Structure and Testing, *Azem K. Yahamed, Michael Joyce, and Paul D. Fleming, Western Michigan University (USA)*

DIGITAL FABRICATION OF FUNCTIONAL PRODUCTS

12:10 – 4:00 PM

Electrohydrodynamic Jet Printing for Columnar Discotic Liquid Crystal Alignment and Applications in Organic Electronics (Focal), *Adam V. S. Parry[1], Daniel J. Tate[1], Richard J. Busby[2], and Stephen G. Yeates[1]; [1]University of Manchester and [2]University of Leeds (UK)*

Application of Inkjet Printing for 3D Integration (Focal), *Kim Eiroma and Heikki Viljanen, VTT Technical Research Centre of Finland (Finland)*

Inkjet Printing of Highly Conductive Graphene-based Composite Inks (Focal), *Mohammad Nazmul Karim, Shaila Afroj, and Stephen G. Yeates, University of Manchester (UK)*

Manufacturing of Touch Sensors Integrated in Decorative Laminates for Furniture Surface, *Wolfgang Schmidt, Rainer Gumbiowski, and Rijk Van der Zwan, Schoeller Technocell GmbH & Co. KG (Germany)*

Rectification Characteristics of Dual-Layered Organic Device Incorporating Ohmic Contact: Triphenylamine Derivative/C60-Doped Triphenylamine Derivative, *Norio Nagayama[1,2], Mitsuhiko Katagiri[1], and Minoru Umeda[1]; [1]Nagaoka University of Technology and [2]Ricoh Company (Japan)*

Exfoliated Layered Materials for Digital Fabrication, *Viviane Alecrim, Renyun Zhang, Magnus Hummelgard, Britta Andres, Christina Dahlstrom, Duc T. Duong, Magnus Norgren, Mattias Andersson, and Hakan Olin, Mid Sweden University (Sweden)*

Fundamental Characteristics on Nano Porous Titania Layer of Dye-Sensitized Solar Cell (DSC) Utilizing Electrostatic 3D Printer (Interactive), *Masafumi Ogawa, Yoshihito Kunugi, and Satoru Iwamori, Tokai University, and Shinjiro Umezu, Waseda University (Japan)*

MONDAY ROUNDTABLE

September 28th • 4:30 – 5:50 PM

Round Table on Surface Manufacturing

Moderator: Steve Simske, Hewlett-Packard Company

One of the key topics, judged by paper submissions and press coverage leading up to the conference, is Surface Manufacturing. Surface manufacturing is customization of a manufactured good by using printing or printing-like processes. Surface manufacturing comprises at least four significant areas of research, development and industrialization. These are: (1) Materials, (2) Scanning, (3) Mass production + mass customization, and (4) Process equivalence, or "substitutability." The materials – plastics, other polymers, ceramics and metals – generally require different production methods, and beg for a hybrid approach to "3D printing," involving multiple technologies and processes. This hybrid approach includes methods not normally associated with additive manufacturing or 3D printing, and so is termed "surface manufacturing." Scanning to 3D models for surface manufacturing includes imaging approaches, systems, and software. Merging mass production with mass customization includes the methods, workflows, processes, accounting systems, track and trace, and authentication associated with other manufacturing and supply chain processes. Finally, process equivalence is the art of re-defining machining and manufacturing processes in light of the realities of surface manufacturing. Creating a set of process equivalents gives the manufacturer more options for completing customized products

In this round table, attendees discuss these four areas, starting as a group and splitting off to consider each area in more depth. Output from the round table will be a white paper used to help the community define its stance moving forward in collaboration with—and directly as—3D printers and surface manufacturers.

Determination of Minimum Inhibitory Concentrations Using Thermal Ink-jet Printing (Interactive), *Cornelius C. Dodoo, Mustafa Alomari, Paul Stapleton, and Simon Gaisford, University College of London (UK)*

ROUNDTABLE ON SURFACE MANUFACTURING

4:30 – 5:50 PM

See details, above.

Tuesday September 29, 2015

ALL TRACKS

TUESDAY KEYNOTE
9:00 – 10:00 AM
3D Deposition of Functional Materials for the Additive Manufacturing of Smart Devices, *Richard Hague, EPSRC Centre for Additive Manufacturing (UK)*

2015 EXHIBITIION
11:00 AM – 6:15 PM
See inside cover for current list of exhibitors.

STATE-OF-THE-ART INVITED TALK: 3D PRINTING
2:30 – 3:10 PM
New File Format for 3D Printing, its Extensions and Applications, *Hiroya Tanaka, Keio University (Japan)*

DRUPA 2016 PREVIEW
3:10 – 3:25 PM
Drupa 2016: Touch the Future, *VP of Messe Duesseldorf*

INTERACTIVE PAPERS, DEMONSTRATION SESSION, AND EXHIBIT HALL HAPPY HOUR
4:20 – 6:15 PM

DIGITAL PRINTING TECHNOLOGIES TRACK

INKJET-BASED PROCESSES CON'T.
10:10 – 11:10 AM
Emerging Hybrid Ink Technology: Challenges of Implementation for Jetting and Print Process, *Mark Bale, SunChemical Ltd. (UK)*
Droplet-on-Demand Printing of Polymer Solutions, *J. Frits Dijksman, University of Twente, and Paul C. Duinveld, Philips Consumer Lifestyle Technology Expert Group (the Netherlands)*
Inkjet Printed P-type Semiconductors and Thin Film Transistors, *Chang-Ho Choi, Zhen Fang, Marshall Allen, and Chih-hung Chang, Oregon State University (USA), and Liang-Yu Lin and Chun-Cheng Cheng, AU Optronics Corporation (Taiwan)*

TONER-BASED PROCESSES
11:50 AM – 4:20 PM
Sponsored by Ricoh Company Ltd.

Technology on Electrostatic Separation of Toner Charge Sign Utilizing Electrostatic Traveling Wave, *Yasuhiro Maruyama, Brother Industries, Ltd. (Japan)*
Development of Dual Heater Technology for On-Demand Fixing System, *Hiroki Eguchi, Masatake Usui, Akira Kato, Atsushi Iwasaki, and Hiroaki Sakai, Canon Inc. (Japan)*
Functionality Evaluation of Airflow-System for Toner Scatter in a Copy Machine, *Kazuya Tamura, Masafumi Kudo, Yasunori Momomura, Minoru Kasama, and Koji Udagawa, Fuji Xerox Co., Ltd. (Japan)*
Gloss Prediction Model for Electro-Photographic Printing based on Image Structures Related to the Physical Phenomena in the Image Forming Processes, *Kenichi Hamada, Minoru Ohshima, Toru Ogawa, and Yoshihisa Kitano, Fuji Xerox Co., Ltd. (Japan)*
Preparation and Characterisation of Model Colloidal Inkjet Inks (Interactive), *Mohmed A. Mulla[1], Huai N. Yow[2], Olivier J. Cayre[1], and Simon R. Biggs[3]; [1]University of Leeds (UK), [2]Briggs of Burton PLC (UK), and [3]University of Queensland (Australia)*
Fusing Study of Silica-Polymer Composite Particles for Toners, *Li Cheng, Jie Wang, Hairuo Tu, Dmitry Fomitchev, Hajime Kambara, Cabot Corporation (USA)*

TUESDAY KEYNOTE

3D Deposition of Functional Materials for the Additive Manufacturing of Smart Devices
Prof. Richard Hague
Department of Mechanical, Materials, and Manufacturing Engineering, University of Nottingham; Head of the Additive Manufacturing and 3D-Printing Research Group; and Director of the EPSRC Centre for Innovative Manufacturing in Additive Manufacturing

This presentation covers the research being undertaken at the University of Nottingham into functional 3D Printing. This research is primarily focused on various jetting techniques including: piezo electric based systems, for both functional and structural inks; functionalized 2-photon lithography, for nano-scale fabrication; and the direct drop on demand jetting of high temperature metallics, using a bespoke system unique to Nottingham.

STATE-OF-THE-ART INVITED TALK: 3D PRINTING FILE FORMATS

New File Format for 3D Printing, its Extensions and Applications
Professor Hiroya Tanaka, Keio University (Japan)

This talk explores the new file formats for 3D printing, such as AMF and 3MF, as well as original extensions and applications. Additionally, it will discuss a Keio University 3D search-engine and voxel-based format.

MATERIALS, METHODS, AND PERFORMANCE TRACK

PRINT SYSTEMS OPTIMIZATION

10:10 AM – 1:00 PM

HP Large Format PageWide Array Printer Servicing Hardware, *Rafael Ulacia, Oscar Moya, Francisco Gomez, and Alejandro Mielgo, Hewlett-Packard Co. (Spain)*

Separation of Granularity into Uniformity Deterioration Factors for Electrophotographic Images, *Yumiko Kishi, Ricoh Company, Ltd. (Japan)*

Newly Developed UV-Curable Inkjet Technology for Digital Inkjet Press KM-1 (Focal), *Toshiyuki Takbayashi, Hirotaka Iijima, Katsunori Goi, Mitsuru Obata, Toshiyuki Mizutani, and Hideo Watanabe, Konica Minolta, Inc. (Japan)*

Intelligent Image Rendition, *Chunghui Kuo, Eastman Kodak Company (USA)*

Embedded Differential Access Control for Printing Variable Jobs, *Nassir Mohammad and Helen Balinsky, Hewlett-Packard Labs (UK)*

Noise Reduction Technology for Density Unevenness in Electrophotographic Process, *Satoshi Kaneko, Shuji Hirai, Shinji Kato, Terumichi Ochi, Shinichi Akatsu, Takeshi Shintani, and Yasuhiro Maehata, Ricoh Company, Ltd. (Japan)*

HYBRID TECHNOLOGIES

3:40 – 4:20 PM

Relationship between Thermal Conduction Process and Transient Temperature Response of Printing Papers in DTP Process, *Takashi Fukue[1], Hirotoshi Terao[2], Koichi Hirose[1], Tomoko Wauke[2], and Hisashi Hoshino[2]; [1]Iwate University and [2]ALPS Electric Co., Ltd. (Japan)*

Applications of Graphene for Imaging Technologies, *Khe Nguyen, HK Investment Production Trading (Vietnam)*

Interpreting the Schedule

By knowing the amount of time allotted for each type of presentation, you can estimate when a particular presentation will occur. Order and times are subject to change; exact times will be published in the conference proceedings. Note there are 30-minute coffee breaks most mornings and afternoons, as well as daily lunch breaks. Presentation lengths include time for Q&A.

Keynote: 50 minutes Focal: 30 minutes
Oral: 20 minutes
Interactive preview: 5 minutes

SPECIAL EVENT: INTERACTIVE PAPERS, DEMONSTRATION SESSION, AND EXHIBIT HALL HAPPY HOUR

September 29th
4:20 – 6:15 PM
Session Chair: David Stüwe, Notion Systems GmbH

DIGITAL FABRICATION AND 3D PRINTING TRACK

3D PRINTING AND ADDITIVE MANUFACTURING DAY 1

10:10 AM – 4:20 PM

Through a Glass Clearly: The Challenge of Glass 3D-Printing, *Michael Avery[1], Susanne Klein[2], Robert Richardson[1], Paul Bartlett[1], and Steven Simske[3]; [1]University of Bristol (UK), [2]Hewlett-Packard Labs (UK), and [3]Hewlett-Packard Labs (USA)*

Voxel-based 3D Processing for 3D Printing, *Atsushi Masumori, Keio University SFC (Japan)*

3D Printing Magnetic Material with Arbitrary Anisotropy (Interactive), *Garrett Clay, Han Song, Jeffrey Nielsen, James Stasiak, Albrecht Jander, and Pallavi Dhagat, Oregon State University (USA)*

Food Printing Technologies out of White Rice (Focal), *Hiroya Tanaka, Yoshihito Asano, Moeka Watanabe, and Atsushi Masumori, Keio University Shonan Fujisawa Campus (Japan)*

Acoustic Properties of 3D Printed Materials, *Daniil I. Nikitichev, Erwin Alles, and Adrien E. Desjardins, University of College London (UK)*

Digital Additive Manufacturing of Autonomous Machines, *Trevor Snyder, 3D Systems (USA)*

Micro 3D Inkjet Printing, *Jie Wang, Yong Zhou, Xiongwei Shi, Sen Yang, Qibin Bao, Yong Zhang, Xiaofei Luo, and Yingcai Xie, Advanced 3D Printing Technology (ZH) Co., Ltd. (China)*

Speed and Accuracy of High Speed Sintering, *Sami Giurani[1], Antonis Hadjiforados[1], Adam Ellis[1], Ingo Reinhold[2], and Neil Hopkinson[1]; [1]University of Sheffield (UK) and [2]XaarJet AB (Sweden)*

Modelling Build Time, Process Energy Consumption and Cost of Material Jetting-based Additive Manufacturing, *Martin Baumers, University of Nottingham (UK)*

Wednesday September 30, 2015

ALL TRACKS

KEYNOTE AND AWARDS
9:00 – 10:00 AM
3D Printed Bionic Nanomaterials, *Michael McAlpine, University of Minnesota (USA)*

2015 EXHIBITIION
11:00 AM – 4:30 PM
See inside cover for current list of exhibitors.

INTELLECTUAL PROPERTY UPDATE AND DISCUSSION
2:50 – 3:30 PM
See details under Digital Printing Technologies Track.

SECURITY PRINTING ROUNDTABLE
4:50 – 5:50 PM
See details, page 17.

CONFERENCE RECEPTION
7:00 – 9:30 PM
Portland Art Museum – Mark Building

DIGITAL PRINTING TECHNOLOGIES TRACK

PAGEWIDE PRINTING
10:10 AM – 2:50 PM
Pagewide System Printhead Architecture for a Compact Printer (Focal), *Clayton Holstun, Ron Burns, Norman Pawlowski, Mohammad Akhavain, and Dan Dowell, Hewlett-Packard Co. (USA)*
High Density Nozzle Architecture Inkjet Printhead for Commercial Industrial Markets (Focal), *Jim Przybyla, Chris Bakker, Eric Martin, and James Gardner, Hewlett-Packard Co. (USA)*
Printer Calibrations for HP Large Format Page Wide Technology, *Martí Rius, Marc Casaldàliga, Romà Segura, and Xavier Fariña, Hewlett-Packard Co. (Spain)*
Designing a Long-Life, Pagewide Printhead, *Stephen Conner, Thom Sabo, Minal Shah, Clayton Holstun, and Brian Canfield, Hewlett-Packard Co. (USA)*
HP Inkjet Large Format Page Wide Array: Solution for Drop Detection and Nozzle Replacement (Focal), *Jose L. Valero, Hewlett-Packard Co. (Spain)*
Large Format Page Wide 1-Pass Printing Challenges, *Isabel Borrell and Xavier Fariña, Hewlett-Packard SA (Spain)*

WEDNESDAY KEYNOTE

3D Printed Bionic Nanomaterials
Prof. Michael McAlpine,
Benjamin Mayhugh Associate Professor in Mechanical Engineering, University of Minnesota

The ability to three-dimensionally interweave biology with nanomaterials could enable the creation of bionic devices possessing unique geometries, properties, and functionalities. McAlpine discusses how the coupling of 3D printing, novel nanomaterial properties, and 'living' platforms may enable next-generation nano-bio interfaces and 3D printed bionic nanodevices.

CONFERENCE RECEPTION

September 30th • 7:00 – 9:30 PM
Portland Art Museum – Mark Building

INTELLECTUAL PROPERTY UPDATE AND DISCUSSION
2:50 – 3:30 PM
Talk followed by extended Q&A/discussion
Patenting Inventions Related to Non-Impact Printing in the U.S. in Light of the Recent Far Reaching Supreme Court Case Related to Software: Alice Corp. V. Cls Bank, 134 S.Ct. 2347 (2014), *Scott M. Slomowitz, Gary A. Greene , and Nicholas M. Tinari, Jr., Caesar, Rivise, Bernstein, Cohen & Pokotilow, Ltd. (USA)*

NOVEL PRINT TECHNOLOGIES AND EXTENSIONS
3:30 – 5:50 PM
Silver Electrodeposition based Multicolor Electrochromic Device Showing CMY Three Primary Color States (Focal), *Norihisa Kobayashi, Kazuki Nakamura, Ryo Onodera, and Ayako Tsuboi, Chiba University (Japan)*
Study of Improved Heating Head High Speed Heating and Efficient Usage (Focal), *Hideo Taniguchi[1], Shigemasa Sunada[1], Jiro Oi[2], and Mark Tatsuya[1]; [1]HIT Devices Ltd. (Japan) and [2]HIT Devices Ltd. (USA)*
Changing Demand- Evaluating Effects Using Simulation as a Service, *Sunil Kothari, Hewlett-Packard Co. (USA)*
Inkjet-Printing of Gold Electrodes Using a Novel Metallo-Organic Decomposition Ink, *Christoph Sternkiker[1], Kai-Ulrich Boldt[2], and Reinhard R. Baumann[1,3]; [1]Technische Universität Chemnitz, [2]Heraeus Deutschland GmbH & Co. KG, and [3]Fraunhofer Institute for Electronic Nano Systems ENAS (Germany)*

MATERIALS, METHODS, AND PERFORMANCE TRACK

SECURITY PRINTING

10:10 AM – 4:50 PM

Inkjet Printing for Secure Documents (Focal), *Alan Hodgson, Alan Hodgson Consulting Ltd.; Matt Hensman, consultant; and David Westgate, National Document Fraud Unit (UK)*

Countering Counterfeiting of Drugs: Unique Fluorescent Inks for Direct Printing onto Pharmaceuticals (Focal), *Brian A. Logue[1], Jamie K. Kern[1], Sierra Rasmussen[2], Jon Kellar[2], and Robert P. Oda[1]; [1]South Dakota State University and [2]South Dakota School of Mines and Technology (USA)*

Functional Summarization of Non-Text Data, *Steven Simske, Marie Vans, and Margaret Sturgill, Hewlett-Packard Labs (USA)*

A Low-Cost Hyperspectral Scanner for Security Printing, *Charles Santori, James Stasiak, Garry Hinch, and Raymond G. Beausoleil, Hewlett-Packard Co. (USA)*

Upconverting Nanoparticle Security Inks based on Hansen Solubility Parameters (Focal), *Jacob Petersen[1], Jeevan Meruga[1], Aravind Baride[2], P. Stanley May[2], William Cross[1], and Jon Kellar[1]; [1]South Dakota School of Mines and Technology and [2]University of South Dakota (USA)*

Additive Manufacturing of Optically Variable Devices Using Inkjet Printing on Optical Nanostructures, *Hao Jiang, Sheida Arabi, Haleh Shahbazbegian, Jasbir N. Patel, and Bozena Kaminska, School of Engineering Service (Canada)*

Porous-Wall Hollow Glass Microspheres for Security Printing Applications, *Forest Thompson and Grant Crawford, South Dakota School of Mines and Technology, and George Wicks, Applied Research Center (USA)*

Structural Color for Security Printing: Patterned Robust Colloidal Crystal, *Takaharu Kobayashi, Research Institute of National Printing Bureau (Japan); and Mark Owens, William Cross, Jon Kellar, and Grant Crawford, South Dakota School of Mines and Technology (USA)*

Recent Advances in Upconversion Nanoparticle Inks in Security Printing (Focal), *Stanley May, University of South Dakota; and Jon Kellar, William Cross, Grant Crawford, and Jeevan Meruga, South Dakota School of Mines and Technology (USA)*

Luminescent or Conductive Nanomaterials Derived Colloidal Solution for Microstructures Fabricated by Digital Jet Print Engineering, *Tran Kim Anh[1,3], Dang Thi My Dung[2], Lam Thi Kieu Giang[1], Fribourg-Blanc[2], Dang Mau Chien[2], and Le Quoc Minh[1]; [1]Vietnamese Academy of Science and Technology, [2]Vietnam National University, and [3]Duy Tan University (Vietnam)*

WEDNESDAY ROUNDTABLE

September 30th • 4:50 – 5:50 PM

Security Printing: Identifying the Opportunities

Moderator: Alan Hodgson, Alan Hodgson Consulting Ltd.

Identifying opportunities for the digital printing community in the area of security printing is the goal of this discussion. Using material presented in the Security Printing Session and short course as a springboard, participants will debate the implications for our industry. Without wishing to prejudge the discussion here are a number of topic areas that might be discussed.

- Printing engines: At present both toner and inkjet engines find application in security printing. Does solid toner have a future here? And where can inkjet add value?
- Substrates: Both paper and plastic substrates are widely used in this sector. What are the print and product opportunities here? There is market demand for secure colour print onto polycarbonate substrates. How can this be achieved?
- Printable Fluids: The physical and chemical characteristics of common inkjet inks and toners have significant weaknesses. How can we address these? Where are the opportunities? And, where are the digital fabrication opportunities in this space?

ROUNDTABLE ON SECURITY

4:50 – 5:50 AM

See details, above

DIGITAL FABRICATION AND 3D PRINTING TRACK

BIO-PRINTING

10:10 – 10:50 AM

Biopolymer-based Functional Inks for the Preparation of Artificial Cartilage via Bioprinting Technology, *Eva Hoch[1], Achim Weber[1,2], Thomas Hirth[1,2], Günter E.M. Tovar[1,2], and Kirsten Borchers[1,2]; [1]University of Stuttgart and [2]Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB (Germany)*

Thermal Inkjet System Enabling Biomolecule Dispensing for Life Science Research, *Jeff Nielsen, Ken Ward, Christie Dudenhoefer, Dave Ochs, Dennis Esterberg, Debora Thomas, Joshua Yu, Ken Duda, and Michael Day, Hewlett-Packard Co. (USA)*

3D PRINTING AND ADDITIVE MANUFACTURING DAY 2

10:50 AM – 1:00 PM

3D Printing in the Development of the Endoscopic Probe, *Daniil I. Nikitichev[1], Simeon J. West[2], and Adrien E. Desjardins[1]; [1]University of College London and [2]University College Hospital (UK)*

Digital Making: 3D Printing and Artisanal Glass Production, *Aaron Oussoren, Keith Doyle, and Philip Robbins, The Emily Carr University of Art and Design (Canada)*

3D Printed Self-Glazing Ceramics: Process and Materials Development, *David Huson and Katie Vaughan, University of the West of England (UK)*

A Study on Reduction of Processing Time and Improvement of Strength by Using Photopolymer Resin in the 3DP Process with Powder Base, *Sungwoo Bae and Dong Soo Kim, Hanbat National University (Korea)*

COLLOIDS AND COLLOIDAL SUSPENSIONS (TONER, PARTICLES, INK FORMULATION)

2:30 – 5:50 PM

Pigmented Ink Technology to Enable Pagewide Technical Production, *Jay Bhatt and Richard McManus, Hewlett-Packard Co. (USA)*

Rheology and Stability of Functionalized Particle Loaded Inkjet Inks, *Danny Lehmann, Klaus Krüger, and Vico Haverkamp, Helmut Schmidt University/ University of the Federal Armed Forces Hamburg; Yaowapa Treekamol, Mauricio Schieda, and Iris Herrmann-Geppert, Helmholtz-Zentrum Geesthacht (Germany)*

Design of Colorant with the High Quality Printing on both of Treated and Non-Treated Papers, *Satoshi Tanaka, Isao Tsuru, and Daisuke Hamada, Kao Corportion (Japan)*

Systematic Ink Design and Solubility Enhancement via Genetic Algorithm for Nanoparticle-based Inkjet Inks (Focal), *Jacob Sadie[1], Himamshu Nallan[1], Steven Volkman[1], Kee-Sun Sohn[2], and Vivek Subramanian[1]; [1]University of California, Berkeley (USA) and [2]Sejong University (Korea)*

Effect of Manufacturing Process on Charging Behavior of Polyester-based Chemically Prepared Toners, *Dinesh Tyagi and Dat Nguyen, Lexmark International, Inc.; and Jarupa Jitsanguan, Colorado School of Mines (USA)*

Attenuation of Crack Pattern in Dried Silica Colloidal Droplets by Anionic Surfactant Addition, *Mahoulo Ahouansou[1], Simon R. Biggs[2], and Olivier J. Cayre[1], [1]University of Leeds and [2]The University of Queensland (UK)*

Advanced LED UV Inkjet Inks for Industrial Applications, *Hiroki Nakane, Mio Kumai, Masayuki Hagi, and Kiyofumi Nagai, Ricoh Company, Ltd. (Japan)*

Thursday October 1, 2015

ALL TRACKS

LATE BREAKING NEWS/SUCCESS STORIES

11:10 AM – 12:30 PM

See details, below.

OFFSITE TOUR: 3D SYSTEMS

2:15 – 4:45 PM

See page 19 for details.

DIGITAL PRINTING TECHNOLOGIES TRACK

INNOVATIVE APPLICATIONS

9:00 – 10:40 AM

Adhesion and Electrical Properties of Low Temperature Processed Ag-PMMA-Films in Inkjet Printing, *Andreas Rathjen, Jan Zimmermann, Vico Haverkamp, and Klaus Krüger, Helmut Schmidt University/University of the Federal Armed Forces Hamburg (Germany)*

Drop Coalescence on Non-Absorbent Coated Substrates, *Jun Ma, David A. Mantell, Xin Yang, and Paul McConville, Xerox Corporation; and Hong Zhao, Virginia Commonwealth University (USA)*

Anomalous Thermal Induced Pinning of a Liquid Drop on a Solid Substrate, *Mandakini Kanungo, Xerox Corporation (USA); Srinivas Mettu, University of Melbourne (Australia); and Kock-Yee Law, Research and Innovative Solutions (USA)*

LATE BREAKING NEWS/ SUCCESS STORIES

Recent Developments and Successes in Printing Technology

Moderator: Werner Zapka, XaarJet AB

The Late Breaking News / Success Stories session addresses those items that need to be considered when implementing digital printing applications into industrial manufacturing lines. Such can be technical or other issues that delay implementation, or they can be new approaches across the full technology chain from inks, print devices, substrates, pre- and post-processes, data flow, machine integration, metrology to the actual implementation on the manufacturing floor.

Call for Participation: Every new implementation and/or addition to that technology chain can help strengthen the standing of our community and the general perception of digital printing/fabrication. We encourage you to present your contribution. To do so, contact NIP_DF@ imaging.org or werner.zapka@xaar.com.

Development of a Novel Bio-based Coating for Water-based Inks Comprising Dye Colorants, *Katriina Mielonen, Sami-Seppo Ovaska, and Kaj Backfolk, Lappeenranta University of Technology (Finland)*

New Media for 1-Pass Printing Applications, *Charlie Zhou, Haowen Yu, Xulong Fu, Pere Canti, Ana de la Rosa, and Lisa Underwood, Hewlett-Packard Co. (USA)*

MATERIALS, METHODS, AND PERFORMANCE TRACK

INK SUBSTRATE INTERACTIONS

9:00 – 10:40 AM

Halftone Structure Analysis for Classifying Print Processes, *Shankhya Debnath, Independent Researcher (India)*

Using Emulsions to Overcome Problems Associated with the Inkjet Printing of High-Molecular-Weight Polymers in Solution, *Ashley S. Johns and Colin D. Bain, University of Durham (UK)*

Characterization of Polymer and Silver Printed Thermoelectric Generators, *Kristina Grunewald, Joachim Bahr, Florian Hofmann, Oleksandr Kravchuk, and Marcus Reichenberger, TH Nürnberg – Georg Simon Ohm (Germany)*

Inkjet Printed Hollow Silica Nanoparticles for Anti-Reflective Coatings, *Yujuan He, Harrison R. Holzgang, Ki-Joong Kim, and Chih-Hung Chang, Oregon State University (USA)*

Path to Low Cost Universal Microfluidic Platform, *Alexander Govyadinov, Erik Torniainen, Pavel Kornilovitch, and David Markel, Hewlett-Packard Co. (USA)*

AD HOC TOPICS/MEETINGS

9:00 – 10:40 AM

For this year's conference, we are reserving a third track on Thursday morning for ad hoc, topical meetings that stem from the "hot topics" that emerge from the first three days of the conference. Because so many of the world's printing, imaging and digital fabrication experts are in one place, we are facilitating these meetings to help consolidate the learning value of the conference and allow attendees to form collaborative efforts moving forward as a consequence of their conference interactions.

OFFSITE TOUR TO 3D SYSTEMS

Thursday, October 1st

Departure: 1:45 pm for 2:15 – 3:45 tour
Return to hotel: by 4:45 pm
Transportation cost: $25 (no refunds given)
Limit: 30 people

Register for the tour when you register for the conference. See reg form, pages 20–21.

3D Systems (headquartered in South Carolina) invented 3D printing in the 80s and continues to engineer and manufacture numerous 3D printers today. 3D Systems recently bought the former Xerox Wilsonville solid ink printer engineering group including mechanical, electrical, software, and chemical engineering personnel and facilities. This is the site where solid ink printing technology was invented, designed, and developed for more than 20 years. 3D Systems has a wide variety of additive manufacturing technologies including SLA, SLS, DMP, MJP, CJP, & PJP. ColorJet Printing and MultiJet Printing both utilize inkjet printing as the material deposition method.

The 3D Systems tour will visit some of the labs and projects in Wilsonville including the engineering facilities and support labs (EMI, sound, packaging, & environmental) used for product development and introduce the numerous additive manufacturing methods designed and sold by the company.

About Portland, OR

Portland is a lively, yet relaxed city known for microbrews, food carts, world-famous rose and Japanese gardens, the artsy Pearl Arts District, Powell's Books, and tax-free shopping, as well as its proximity to a stunning Pacific Ocean coastline, vibrant wine making region (famous pinot noirs and pinot gris), and the beautiful Columbia Gorge Valley and Cascade Mountains.

The conference's location promises to delight all attendees, from those who love nature and the outdoors to those who love exploring cuisines of the world. For more information about Portland visit http://www.travelportland.com/.

Late September weather ranges from 71°F/21°C to 46°F/7°C and can be rainy.

DIGITAL FABRICATION & DIGITAL PRINTING 2015 / NIP31 REGISTRATION

Register online at www.imaging.org/ist/conferences/nip_df

First/Given Name_____

Last/Family Name _____

Title/Position _____

Company _____

Complete Mailing Address _____

_____

Telephone _____ Fax _____

Email _____

Conference registration includes: admission to all technical sessions; proceedings abstract book + full papers on USB flash drive; entrance to the exhibit; coffee breaks; and the Welcome and Conference Receptions. **Separate registration fees are required for short courses.**

I would like to reserve the following space for a print sample:* ____2' x 4' or ____4' x 4'
I would like a half-table to demonstrate a program/product related to the talk I am giving:*
(Session and Paper Title): _____

Conference Registration (CHECK ONE)	**until 8/31**	**after 8/31**	**TOTAL**

Please check ALL that apply. I am a:

❒ speaker ❒ session chair ❒ committee member ❒ IS&T member ❒ ISJ member

Please note: To better serve your needs, IS&T is offering four conference registration options (+ student and one-day options). One for current IS&T/ISJ members; one for non-members that includes registration only; and two options for non-members that includes IS&T membership from now until Dec. 2016, plus an online subscription to the Journal of Imaging Science and Technology (JIST) *or the* Journal of Electronic Imaging (JEI).

___ Conference registration: IS&T/ISJ Member	$775	$875	$ _____
___ Conference registration: non-member	$875	$975	$ _____
___ Conference registration (with comp membership + JIST)** Membership begins within 2 weeks of registration and expires 12/31/16.	$875	$975	$ _____
___ Conference registration (with comp membership + JEI)** Membership begins within 2 weeks of registration and expires 12/31/16.	$875	$975	$ _____
___ IS&T/ISJ Student Member (ID required)	$170	$270	$ _____
___ Student Non-member (ID required)	$350	$450	$ _____
___ One-day: ❒ Mon ❒ Tues ❒ Wed ❒ Thurs	$490	$490	$ _____
___ Short course only (check and proceed to short course selection area)			

Extra Proceedings

Registration includes proceedings abstract book + full papers on USB flash drvie.

Hardcopy proceedings book (full papers) _____ @$100/each $ _____
Extra abstract book + USB flash drive _____ @$140/each $ _____
Extra USB flash drive _____ @$100/each $ _____

Page Subtotal $ _____

continued on next page

* You will be contacted by the Demonstration Session chair with further details.
** If you choose this option, you may register for Short Courses at the Member rate.

DIGITAL FABRICATION & DIGITAL PRINTING 2015 / NIP31 REGISTRATION CONT'D.

We recognize that changes in the imaging industry have put some of our loyal attendees in strained financial situations. If you are currently unemployed, but would still like to attend this year's meeting, please contact dsmith@imaging.org to discuss your situation.

Short Course Registration (see page 1 for course descriptions)	**until 8/31**	**after 8/31**	
Member registration	$160	$210	$ _____
Non-member registration	$195	$245	$ _____
Student registration	$60	$110	$ _____

Check all that apply: ❑ SC01 ❑ SC02 ❑ SC03 ❑ SC04 ❑ SC05 ❑ SC06 ❑ SC07 ❑ SC08
❑ SC09 ❑ SC10 ❑ SC11 ❑ SC12 ❑ SC13 ❑ SC14 ❑ SC15 ❑ SC16 ❑ SC17

OR

Take three or more classes and receive 20% off the total price*

(enter three or more two-hour courses, fill in member or non-member fee next to each, add together, and multiply by .80 to get your price, representing 20% savings; add additional lines if needed; students may not take advantage of this offer)

T____ $ _____ + T____ $ _____ + T____ $ _____ = $_____ x .80 = $ _____

Membership	**US Address**	**Non-US Address**	
new membership (begins now, expires 12/31/16)	$145	$160	$ _____
annual membership renewal (expires 12/31/16)	$95	$105	$ _____
student membership (begins now, expires 9/30/16)	$25	$25	$ _____

for all memberships select one: ❑ JIST online ❑ JEI online

join now and calculate fees based on member rates

Tour

❑ 3D Systems Tour (cost covers transportation to/from site from/to hotel)	$25	$ _____

Note: No refunds are given for the tour transportation fee.

Social Events

___ Guest/spouse registration (Name: _____) includes the Welcome and Conference receptions	$85	$ _____
___ Extra Welcome Reception Ticket (Name: _____)	$40	$ _____
___ Extra Conference Reception Ticket (Name: _____)	$55	$ _____
Subtotal from previous page		$ _____
Wire transfer fee ($25 if applicable)		$ _____
GRAND TOTAL		**$ _____**

Payment Method: ❑ AmEx ❑ MasterCard ❑ VISA ❑ Discover ❑ Wire Transfer ❑ Check

Card#: _____ Exp. Date: _____

Name as it appears on card: _____

Authorization Signature: _____

Return this form with signed credit card authorization to
IS&T, 7003 Kilworth Lane, Springfield, VA 22151 or fax to 703/642-9094.
We do not encourage sending via e-mail.
Contact registration@imaging.org for wire transfer information.
Please note, $25 must be added to the Grand Total for wire transfer payments to cover bank costs.

Please note: To cover bank charges and processing fees, there is a cancellation fee of $75 until September 21, 2015. After that date, the cancellation fee is 50% of the total plus $75. No refunds will be given after October 16, 2015. All requests for refund must be made in writing.

****Contact Donna Smith (dsmith@imaging.org) for Exhibitor Registration and Information****

NIP31/Digital Fabrication 2015

Society for Imaging Science and Technology
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Springfield, VA 22151 USA
703/642-9090; 703/642-9094 (fax)
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Join us
Sept. 27- Oct. 1, 2015
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