

34th International Conference on Digital Printing Technologies (NIP)

NIP/DIGITAL

DIGITAL

Printing for Fabrication 2018

materials, applications, and processes

September 23-27, 2018 • Dresden, Germany



PRELIMINARY PROGRAM



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Collocated event

2018 International Symposium on
Technologies in Digital Photo Fulfillment

**Early Registration Deadline:
August 26, 2018**

www.imaging.org/print4fab



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Conference Committees



Printing for Fabrication 2018



Technologies in
Digital Photo
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**Printing for Fabrication
(Digital Printing / Digital
Fabrication / NIP) Group**
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Week At-a-Glance

Sunday, Sept. 23

- Short Courses
- Welcome Reception at Westin Historic Beergarden & Fountain

Monday, Sept. 24

- Opening Keynote: Organic Semiconductors: From Vacuum Deposition to Printing, *Karl Leo, Technische Universität Dresden (Germany)*
- Afternoon Keynote: Printing Future Electronic Devices with Organic Semiconducting Materials, *Mark James, Merck Chemicals Ltd. (UK)*
- Technical Sessions:
 - Ink/Substrate Interaction
 - Printed Functional Devices
 - International Symposium on Technologies in Digital Photo Fulfillment 2018
- Colleague Connections: Print4Fab Speed Networking Event
- Young Professional/Student Get Together

Tuesday, Sept. 25

- IS&T Award Presentations
- Keynote: Electronic Skins Connecting Cyberspace and Human, *Takao Someya, University of Tokyo (Japan)*
- Exhibition
- Technical Sessions
 - Digital Textile Printing
 - Printed Electronics: Materials
 - Healthcare
 - Lab2Fab Challenges
 - IP & Standards
- Interactive Paper (Poster) Sessions
- Demonstration Session / Happy Hour

Wednesday, Sept. 26

- IS&T Award Presentations
- Morning Keynote: Advances in Additive Manufacturing: The Evolution of HP Inc.'s Jet Fusion™ 3D Printing Technology, *Cheryl MacLeod, HP Inc. (US)*
- Afternoon Keynote: Industrial Applications of Inkjet Technologies, *Rich Baker, Integrity Industrial Ink Jet Integration LLC (US)*
- Exhibition
- Technical Sessions
 - Inkjet Processes I
 - 3D Printing
 - Security Printing I
- Technology Networking Event: Connections for Innovation in Security Printing
- Colleague Connections: Inkjet Open Forum
- Conference Reception Elbe rivercruise aboard the August der Starke paddle boat

Thursday, Sept. 27

- Closing Keynote: 2018-2020—The Time to Go Industrial with Digital Packaging Production, *Montserrat Peidro, Heidelberger Druckmaschinen (Germany)*
- Technical Sessions
 - Inkjet Processes II
 - Production Printing
 - Security Printing II
- Technology Networking Event: Late Breaking News
- Colleague Connections: Technology Tours

The Venue

Dresden, Germany

The 34th in IS&T's digital printing (NIP) conference takes place in Dresden, the capital of the Free State of Saxony in eastern Germany. Dresden lies on the banks of the Elbe River, close to Berlin and the Czech Republic.

Saxony is home to numerous printing technology-related companies and many fine institutions of higher learning including 17 Fraunhofer, 8 Leibnitz, 6 Max Planck, and 3 Helmholtz research institutes, the Technical Universities of Chemnitz, Dresden, and Freiberg, and print/media-related programs at the universities of applied sciences in Mittweida and Leipzig. Its history as a center of research,

mechanical design, engineering, and manufacturing began in the early 1700s with the first European china manufacture and has evolved since.

Known as the Jewel Box, because of its gorgeous baroque and rococo city center, Dresden was virtually destroyed by controversial Allied bombings at the end of WWII. The city has been painstakingly restored to its former glory and delights with its ornate architecture, monumental museums, and riverside charm.

In the heart of the old city, just steps from the iconic Frauenkirche Dresden and the Dresden Castle, the Hilton Dresden hosts the 2018 conference.

Don't miss the chance to convene with colleagues, learn more about printing for fabrication, and explore this stunning city.

Special Event: Technology Tours

Note on Tours: All tours take place on **Thursday 27 September**. Buses leave from and return to the Dresden Hilton. Tour times are approximate. Arrival back at the hotel is estimated based on normal travel times, but cannot be guaranteed. Tour cost helps cover administrative costs plus the cost of the box lunch; these fees are non-refundable, but you may find someone to take your place if you cannot attend. Both tours are limited to 50 attendees. Reservation is first come/first served. A waiting list will be available onsite. Additional tours may be added, please monitor the conference website for all current updates and details.

From Pulp to Photo Cards Felix Schoeller Group Weißenborn Paper Mill: A Fully-integrated Imaging Site

Time: approx. 13:30 to 18:00 (tour is ~4-5 hours including a one-hour bus drive in each direction)

Visit the Weißenborn paper mill, which began a transformation in 1998 into the only fully-integrated production site worldwide for imaging papers (photo imaging and digital media). Under the umbrella term IQ – Integrated Quality – all production steps take place here under one roof, from production of the raw paper, through all the refining steps, to converting and storage. With an annual capacity of 105,000 tons—and 840 employees—the mill features one paper machine, two extruders, and three coaters, one of which is the largest imaging paper coater in the world.

Upon arrival, attendees are given a short introduction. They then break into small groups and spend about 90 minutes touring the papermaking, paper coating (polymer extrusion and aqueous coating), converting, and warehousing facilities. Refreshments are provided.

The tour and refreshments are sponsored by Felix Schoeller Group. For more information about the mill, visit https://www.felix-schoeller.com/en_en/company/profile/sites.html (look for the locations drop down menu and select Weißenborn).

Non-refundable fee: \$30
(includes box lunch to eat on bus)

The tour is sponsored by Felix Schoeller Group



Felix Schoeller Group

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Smart Systems Campus in Chemnitz / Saxony

Time: approx. 13:00 to 18:00 (tour is ~6 hours including a one-hour bus drive in each direction)

The Chemnitz Smart Systems Campus concentrates many interesting R&D activities within walking distance of each other including: MEMS development, manufacturing, and applications; digital manufacturing in various industries (automotive, aero, optics, etc.); manufacturing of printed and hybrid electronics; and machinery and appropriate applications. After a welcome and overview, participants will spend about two hours touring the facilities before enjoying some farewell refreshments. The tour covers the following facilities:

- TU Chemnitz printed functionality labs
- Fraunhofer ENAS MEMS & Printed Functionality labs
- Joint DigiFabLab of Fraunhofer ENAS and 3D-Micromac (microFLEX Machinery)
- Showroom of 3D-Micromac including 3D-Microprint for 3D printing (powder)
- and we are working on more ...

Non-refundable fee: \$30
(includes box lunch to eat on bus)

The tour is sponsored by 3D Micromac, Fraunhofer ENAS, and the City of Chemnitz.



Technical and Social Program

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

See page 11 for details on Sunday's Short Course Program, which offers 16 classes on a wide range of topics, at various knowledge levels.

SPECIAL EVENT: WELCOME RECEPTION

Kick off the conference by meeting friends and colleagues Sunday after the Short Courses.

Sunday, September 23rd

18:15 – 19:45

Westin Historic Beergarden and Fountain

SPECIAL EVENT: STUDENT AND YOUNG PROFESSIONALS GET TOGETHER

Join other students and young professionals to explore Dresden's nightlife.

Monday, September 24th

beginning around 19:00; details forthcoming

Monday September 24, 2018

ALL TRACKS

OPENING KEYNOTE

9:00 – 10:00

Organic Semiconductors: From Vacuum

Deposition to Printing, Karl Leo, Technische Universität Dresden (Germany)

AFTERNOON KEYNOTE

14:00 – 14:50

Printing Future Electronic Devices With Organic

Semiconducting Materials, Mark James, Merck Chemicals Ltd. (UK)

TECHNOLOGY NETWORKING EVENT

Print4Fab Speed Networking

17:20 – 18:20

TRACK 1

INK/SUBSTRATE INTERACTION

10:20 – 17:20

Session sponsored by Ricoh.

RICOH

Functional Paper for Sublimation Printing and

Transfer (Focal), Michael Jocher, Sebastian Scholz, Emanuele Martorana, Dirk Hörschemeyer, Georg Bieniek, and Knut Hornig, Schoeller Technocell GmbH & Co. KG (Germany)

Development of an Optimized Nonwoven

Substrate for Digital Printed Wallpaper, Knut Hornig, Michael Avermann, Dieter Goepfert, and Dieter Kaumkoetter, Schoeller Technocell GmbH & Co. KG (Germany)

Study on Printing Performance of Degradable Poly(lactic Acid) Film Packaging Material, Hongge Guo, Qilu University of Technology (China)

Basic Study on Effects of Water Content on Equivalent Thermal Conductivity of Thermal

OPENING KEYNOTE

Organic Semiconductors:

From Vacuum Deposition to Printing

Karl Leo, Dresden Integrated Center for Applied Physics and Photonic Materials (IAPP), Technische Universität Dresden (Germany)

Organic semiconductors consisting mostly of carbon are currently intensively investigated for electronic and optoelectronic applications. They offer key advantages, such as flexibility, easy recycling, low cost, and many more. In the first part of this talk, I will discuss some of the recent progress on devices such as highly efficient OLED, solar cells, transistors, and sensors and discuss the many novel applications these "soft" electronic devices" offer. In the second part, I will address manufacturing issues and discuss how the field of organic electronics will move from the current vacuum techniques to low-cost printing.

Printing Paper, Takashi Fukue¹, Hiroto Terao², Koichi Hirose³, Tomoko Wauke², Hisashi Hoshino², and Koji Sato³; ¹Kanazawa Institute of Technology, ²Alps Electric Co., Ltd., and ³Iwate University (Japan)

Tall Oil Rosin: A Substitute for Gum Rosin in Development of Offset Printing Ink (Interactive

Preview), Mahuya Biswas and Srabana Kundu, DIC India Limited, and Shankhya Debnath, Regional Institute of Printing Technology (India)

Facile Strategy for the Fabrication of Superhydrophobic Paper with Superior Stability Against Deformations (Interactive Preview), Qing

Wang^{1,2}, Guangxue Chen^{1,2}, Zhaohui Yu¹, Linyi Chen¹, Rui Guo¹, and Min Li¹; ¹Shenzhen YUTO Packaging Technology Co., Ltd. and ²South China University of Technology (China)

Evaluating Line Qualities Attributes of Specialty Inks on Photographic Substrates for Inkjet,

Mihir Choudhari, Shu Chang, and Christine Heusner, Rochester Institute of Technology (US)

Stability of Line Structures Produced by Inkjet Printing, Jinxin Yang and Brian Derby, University of Manchester (UK)

New White Pigment Ink: Correlation between Structure of Inorganic Particles and White Opacity, Tomohiro Hirade, Ricoh Co., Ltd. (Japan)

A Study on the Coupling Analysis between Structural and Particles for Toner Leakage Prediction, Yunki You, Jungro Seo, Taehan Kim, HP Printing Korea; Cheol O. Ahn, Metariver Technology; and Yooseok Kim Taesung S&E (South Korea)

Water based Green Lithography, Haihua Zhou and Yanlin Song, Chinese Academy of Sciences (China)

COLLEAGUE CONNECTIONS

Print4Fab Speed Networking

17:20 – 18:20

Join colleagues in a fast and fun session that helps you learn about the technical expertise and interests of others attending the conference.

TRACK 2

PRINTED FUNCTIONAL DEVICES

10:20 – 18:20

Printed Flexible Pressure Sensor for Robot Skin (Focal), Atsushi Nakajima^{1,2}, Toru Miyoshi¹, Kenji Kohiro^{1,3}, Motoshi Itagaki¹, Toshihide Kamata^{1,4}, and Tetsuo Urabe^{1,4}; ¹Japan Advanced Printed Electronics Research Association (JAPER), ²Konica Minolta, Inc., ³Sumitomo Chemical Co., Ltd., and ⁴The National Institute of Advanced Industrial Science and Technology (AIST) (Japan)

Fabrication and Characterization of Different Sensors on Paper as a Flexible Substrate, Goran Stojanovic and Tijana Kojic, University of Novi Sad (Serbia)

A Study of the Potentiality of Inkjet Printing Technique for the Fabrication of Organic Metal-Insulator-Semiconductor Rectifying Diodes, Silvia Conti¹, Carme Martinez-Domingo^{1,2}, and Eloi Ramon¹; ¹Instituto de Microelectrónica de Barcelona and ²Universitat Autònoma de Barcelona (UAB) (Spain)

Development and Evaluation of Inkjet Printed TFTs based on Architecture, Materials, and Process Deposition for Better Suitability to Flexible Electronics, Kalyan Mitra¹, Sunil Kapadia¹, Maxim Polomoshnov¹, Ralf Zichner², and Reinhard Baumann^{1,2}; ¹Technische Universität Chemnitz and ²Fraunhofer Institute for Electronic Nano Systems (Germany)

Preparation of Highly Conductive Poly (3,4-ethylenedioxythiophene) Flexible Thin Films Electrode (Interactive Preview), Xiujie Hu, Chinese Academy of Sciences (China)

Special Pattern Design based on Printed Electronics (Interactive Preview), Yingmei Zhou, Shanghai Publishing and Printing College (China)

MONDAY AFTERNOON KEYNOTE

Printing Future Electronic Devices with Organic Semiconducting Materials

Mark James, Merck Chemicals Ltd. (UK)

Merck has been actively researching organic electronic materials since before 2000, with the objectives to develop products that enable mass production of electronic devices with new functionality not readily obtainable using existing silicon technologies. Multi-disciplinary innovation is required to develop many interrelated materials and processes in parallel to realize these step-change technologies. This talk discusses this process as well as the development of solution processable and printable, functional material sets, covering the technologies of OLED, OTFT, OPV, and OPD.

How the co-development of polymeric organic semiconductors, passive materials, and formulations with process optimisation enable the printing of high performance OTFT backplane arrays, with charge carrier mobility greater than 2 cm²/Vs, suitable for the mass production of printed flexible displays and sensors is also presented.

Preparation of Graphene/Cellulose Composite Conductive Films (Interactive Preview), Fuqiang Chu, Qilu University of Technology (China)

Flexible Circuits Fabricated through Inkjet Printing (Interactive Preview), Xingye Zhang, Chinese Academy of Sciences (China)

Inkjet Printing for MEMS Device, Matti Mäntysalo, Mika-Matti Laurila, and Behnam Khorramdel, Tampere University of Technology (Finland)

Fabrication of Large Area Inkjet-Printed OTFTs on Flexible Substrates: Manufacturing Challenges and Electronic Design Constraints, Eloi Ramon, Institute of Microelectronics of Barcelona IMB-CNM (CSIC) and Universitat Autònoma de Barcelona (UAB) (Spain)

Micro-Reactive Inkjet Printing of Polyaniline, Mei Ying Teo, Logan Stuart, Kean Aw, and Jonathan Stringer, University of Auckland (New Zealand)

PANI-Graphene Nanocomposite as an Active Material for Large-Scale Low-Cost Electrochemical Double Layer Capacitors, Rekha Singh¹, Thomas Weissbach², Tino Zillger², Anil Kumar¹, and Arved Hübler²; ¹Indian Institute of Technology Bombay (IITB) (India) and ²Chemnitz University of Technology (Germany)

Flexible High-Performance Metallic Interconnects Prepared by Innovative Diode Laser Array Treatment of Inkjet-Printed Layers, Mykola Vinnichenko¹, Marco Fritsch¹, Junchen Xiao¹, Denys Makarov², Tetiana Voitsekhivska², Viktor Sauchuk¹, and Mihails Kusnezoff¹; ¹Fraunhofer Institute for Ceramic

Technologies and Systems IKTS and ²Helmholtz-Zentrum Dresden-Rossendorf (Germany)

Laser Sintering of Copper Oxide Nanoparticles Ink, Md. Khalilur Rahman^{1,2}, Zhao Lu¹, and Kye Si Kwon¹; ¹Soonchunhyang University (South Korea) and ²Comilla University (Bangladesh)

JIST-FIRST Process Development of Large Area R2R Printing and Sintering of Conductive Patterns by Inkjet and Infra-Red Technologies Tailored for Printed Electronics, Kalyan Mitra¹, Sunil Kapadia², Melinda Hartwig², Enrico Sowade³, Zhenxing Xu⁴, Ralf Zichner¹, and Reinhard Baumann²; ¹Fraunhofer Institute for Electronic Nanosystems ENAS, ²Technische Universität Chemnitz, ³Zschimmer & Schwarz, and ⁴Padaluma Ink-Jet-Solutions GmbH & Co. KG (Germany)

JIST-FIRST Inkjet Printing and Intense Pulsed Light (IPL) Sintering of Multiwall Carbon Nanotubes (MWCNTs) for Sensor Applications, Dana Mitra, Tatiana Zubkova, Carina Gerlach, Dominique Miesel, Olfa Kanoun, Heinrich Lang, and Reinhard Baumann, Technische Universität Chemnitz (Germany)



**TRACK 3
INTERNATIONAL
SYMPOSIUM ON
TECHNOLOGIES FOR
DIGITAL PHOTO
FULFILLMENT 2018**

Program will be released in late July via the conference webpage.

TUESDAY KEYNOTE

Electronic Skins Connecting Cyberspace and Human

Takao Someya, University of Tokyo (Japan)

Wearable electronics are expected to open up a new class of applications ranging from health-monitoring, motion-capturing, human-machine interfaces, and new IT fashion. In order to expand emerging applications of wearable technologies, printed flexible biomedical sensors have attracted much attention recently. To minimize the discomfort of wearing sensors, it is highly desirable to use soft electronic materials particularly for devices that come directly into contact with the skin and/or biological tissues. In this regard, electronics manufactured on thin polymeric films, elastomeric and textile substrates by printing are very attractive. This keynote reviews recent progresses of wearables and artificial electronic skins (E-skins) from the contexts of high-precision and long-term vital signal monitoring. Furthermore, the issues and the future prospect of wearables and beyond wearables is addressed.

Tuesday September 25, 2018

ALL TRACKS

TUESDAY KEYNOTE AND AWARDS

9:00 – 10:00

Keynote: Electronic Skins Connecting Cyberspace and Human, Takao Someya, University of Tokyo (Japan)

2018 EXHIBITION

10:00 – 17:30

See inside cover for current list of exhibitors.

**INTERACTIVE PAPER SESSION/
DEMONSTRATIONS/EXHIBITS/HAPPY HOUR**

16:00 – 17:30

TRACK 1

DIGITAL TEXTILE PRINTING

10:20 – 16:00

Digital Textile Printing: Current State and Transformation to Digital Textile Manufacturing (Focal), Ronald Askeland, Howard Doumaux, and Edward Davis, HP Inc. (US)

Inkjet Printing of Textiles – Inkjet Ink Formulations and Further Textile Auxiliaries, Enrico Sowade, Oliver Richter, Peter Oehme, Nora Wetzold, Julia Ahrens, and Andreas Schoenfeld, Zschimmer & Schwarz (Germany)

Synergistic Effect of Pre-Treatment Solution and Inkjet Ink to Control Coloring Characteristics on Fabric, Yoshitaka Miyajima, Takuya Sonoyama, and Hiroshi Kiguchi, Seiko Epson Corporation (Japan)

The Effect of Surface Structure and Performance of Cotton Fabric on the Resolution of Ink-Jet Printing, Zhen Shi, Rui Dan, Longyun Hao, Weichao Chen, Ruyi Xie, and Kuanjun Fang, Qingdao University (China)

Influence of 3D Printing on Physical Properties of Textiles (Focal), Sarah Göbel, Saxon Textile Research Institute (Germany)

Effects of Polyols Solvents on Rheological Properties of Reactive Dye Inks for Textile Digital Inkjet Printing (Interactive Preview), Ruyi Xie, Kuanjun Fang, Weichao Chen, Longyun Hao, and Zhen Shi, Qingdao University (China)

Improved Stability of Disperse Dyes/Polymer Composite Nanospheres for Aqueous Inkjet Inks (Interactive Preview), Yawei Song, Kuanjun Fang, and Weichao Chen, Qingdao University (China)

A Novel Four-Color Dyes/P(St-BA-MAA) Nanosphere Dispersions with High Dye Absorption for Inkjet Inks (Interactive Preview), Kuanjun Fang, Yawei Song, Weichao Chen, Ruyi Xie, and Zhen Shi, Qingdao University (China)

Integrative Digital Manufacturing Approach for Processing Technical Textiles, Frank Siegel, Sarah Göbel, Dirk Wenzel, Falko Schubert, and Sten

Döhler, Saxon Textile Research Institute (STFI), and Andreas Böhm, futureTEX Management GmbH (Germany)

Functionalization of Textiles by Screen Printing – Realization of Protective Textiles Against Mechanical Risks, Maren Gültner and Romy Naumann, Saxon Textile Research Institute (Germany), and Dita Krácalová and Jirí Procházka, SINTEX a.s. (Czech Republic)

Printed Hybrid System on Technical Textiles: Battery, Communication Elements, Antennas, Conductive Paths, Carmen Meuser, Andreas Willert, and Ralf Zichner, Fraunhofer Institute for Electronic Nano Systems ENAS (Germany)

Printed Conductive Patterns on Technical Textiles, Christian Zeiner, Technische Universität Chemnitz (Germany)

3D INTERACTIVE PREVIEWS

New and Unique Hotend for 500°C Range 3D FDM/FFF Usage (Interactive Preview), Jiro Oi, HIT Research Corporation (US)

Study on the Influencing Factors of Printing Speed for Paper-based 3D Printing under Cutting and Bonding Scheme (Interactive Preview), Liuxi He, Shenzhen YUTO Packaging Technology Co., Ltd. (China)

**INTERACTIVE PAPER SESSION/
DEMONSTRATIONS/EXHIBITS/HAPPY HOUR**
16:00 – 17:30

TRACK 2

PRINTED ELECTRONICS: MATERIALS
10:20 – 13:10

Room Temperature Interconnection of Silicon Solar Cells Using a Liquid Metal (Focal), Dong-Youn Shin and Hae Wook Chung, Pukyong National University, and Hyung-Jun Song, Jeong In Lee, and Gi-Hwan Kang, Korea Institute of Energy Research (South Korea)

Direct Printing of Conductive Metal Lines from Molten Solder Jets via StarJet Technology on Thin, Flexible Polymer Substrates, Zhe Shu¹, Björn Gerdes¹, Lutz Riegger¹, Roland Zengerle^{1,2}, and Peter Koltay^{1,2}; ¹Albert-Ludwigs-Universität Freiburg and ²Hahn-Schickard-Gesellschaft für angewandte Forschung e.V. (Germany)

JIST-FIRST Piezoelectric Inkjet Printed Metallic Igniters, Jeffrey Rhoads, Allison Murray, Whitney Novotny, Nikhil Bajaj, I. Gunduz, Steven Sun, and George Chiu, Purdue University (US)

New Developments in Printed Electronics Using Offset Lithography on Paper Substrates, Rakel Herrero, CEMITEC (Fundación Cetena) (Spain)

Functional Integration in Fiber Reinforced Plastics (FRP) by use of Digital Printing (Focal), Volker Zöllmer, Katharina Haag, Jonas Deitschun,

INVITATION TO SHOWCASE YOUR SOFTWARE AND/OR HARDWARE Printing for Fabrication Demonstration Session

Technology demonstrations by industry and academic participants showcase the latest developments driving next generation printing products.

This popular event provides authors with an additional opportunity to showcase their work. Authors are offered a complimentary half-table on which to display hardware and/or software related to papers presented at the conference (assuming they register by the Demo Session deadline). Non-authors may take advantage of this opportunity for a small fee that covers expenses.

Indicate your interest in demonstrating when you register for the conference.

and Dirk Godlinski, Fraunhofer-Institute for Manufacturing Technology and Advanced Materials IFAM (Germany)

Generalized Computational Halftone Image Formation (Interactive Preview), Chunhui Kuo, Eastman Kodak Company (US)

Spectral Reconstruction of Chinese Painting based on Manifold Learning Method in Graphic Communication (Interactive Preview), Meiqi Lin, Qilu University of Technology (China)

Research on Several Models of Computer Color Matching for Flexographic Printing based on Improved BP Neural Network (Interactive Preview), Xiaozhou Li, Jingqiang Jia, Mingming Cui, and Yu Liu, Qilu University of Technology (China)

LAB2FAB CHALLENGES

14:30 – 16:00

A Novel Process of Automated Waveform Optimization, Kyle Pucci, ImageXpert Inc. (US)

Planning and Integration of a Non-Standard Inkjet Print Process into an Industrial Manufacturing Line—View of an Integrator, Uwe Buerklin, Thieme GmbH & Co KG (Germany)

Substrate Transport for Production at Variable Process Speeds, Robert Thieme¹, Thomas Oberle¹, Martin Porschen^{1,2}, and Christoph Ziegler¹; ¹GT+W GmbH and ²TU Darmstadt (Germany)

Advanced Laser-based Manufacturing for Digital Fabrication (Focal), Tino Petsch, 3D-Micromac AG (Germany)

**INTERACTIVE PAPER SESSION/
DEMONSTRATIONS/EXHIBITS/HAPPY HOUR**
16:00 – 17:30

TRACK 3

HEALTHCARE

10:20 – 14:50

Personalized Medicine and 2D Drug Printing Using Industrial Inkjet Printing Technology (Focal),

Patrizia Ghiotti, UCB S.A. (Belgium), and Massimo Bresciani and Wen-Kai Hsiao, Research Center Pharmaceutical Engineering GmbH (Austria)
Industrial Inkjet Printing for On-Demand Manufacturing of Film-in-Capsule Dosage Forms, *Wen-Kai Hsiao¹, Diogo Lopes¹, Laura Hauser², Thomas Wutscher¹, Amrit Paudel¹, Massimo Bresciani¹, Johannes Khinast¹, and Andreas Zimmer²;*

¹Research Center Pharmaceutical Engineering and ²University of Graz (Austria)

Digital Printing for Healthcare Solutions, *Hannah O'Brien and Alan Hudd, Alchemie Technology Ltd. (UK)*

Inkjet Printing Platforms for Antibody- and DNA-based Pathogen Detection, *Min Zhao, Purdue University (US)*

Bioink Development and Bioprinting Bio-based Matrices (Focal), *Kirsten Borchers^{1,2}, Eva Hoch³, Annika Wenz³, Birgit Huber³, Sandra Stier⁴, Lisa Sewald², Christiane Claaßen², Petra Kluger³, and Achim Weber^{1,2};* ¹Fraunhofer-Institute for Interfacial Engineering and Biotechnology IGB, ²University of Stuttgart, and ³Formerly: University of Stuttgart, ⁴Formerly: Fraunhofer-Institut für Interfaciale Engineering und Biotechnologie IGB (Germany)

Personalising Medicines by Drug Printing, *Maren Preis, Abo Akademi University (Finland)*

Real World Smart Packaging for Pharmaceuticals, *Micheal Petersen, Information Mediary Corp. (Canada)*

IP & STANDARDS

14:50 – 16:00

International Standards Enabling Printed Electronics for Wearables, *Alan Hodgson, Alan Hodgson Consulting Ltd. and University of Manchester (UK)*

Overview of Standardization Activities for Inkjet Additive Manufacturing (within IEC TC 119 Printed Electronics), *Kei Hyodo^{1,2} and Shinri Sakai²;*

¹Yuasa System Co. Ltd. and ²Yamagata University (Japan)

Basics of Standard Essential Patents and Licensing Them, *Scott Slomowitz, Caesar Rivise, PC (US) with extended discussion time*

INTERACTIVE PAPER SESSION/ DEMONSTRATIONS/EXHIBITS/HAPPY HOUR

16:00 – 17:30

Wednesday September 26, 2018

ALL TRACKS

WEDNESDAY MORNING KEYNOTE AND AWARDS

9:00 – 10:00

Advances in Additive Manufacturing: The Evolution of HP Inc.'s Jet Fusion™ 3D Printing Technology, *Cheryl MacLeod, HP Inc. (US)*

WEDNESDAY AFTERNOON KEYNOTE

14:00 – 14:50

Industrial Applications of Inkjet Technologies, *Rich Baker, Integrity Industrial Ink Jet Integration LLC (US)*

2018 EXHIBITION

10:00 – 16:10

See inside cover for current list of exhibitors.

CONNECTIONS FOR INNOVATION IN SECURITY PRINTING

The Fabrication Needs of Secured Print

16:30 – 17:30

COLLEAGUE CONNECTIONS:

Inkjet Open Forum

17:10 – 17:30

CONFERENCE RECEPTION

18:00 – 21:00

August der Starke Paddle Steamer

TRACK 1

INKJET PROCESSES I

10:20 – 17:10

Session sponsored by Xaar.



Newly Developed MEMS Printheads for Industrial Inkjet Applications, *Kenji Mawatari, Konica Minolta, Inc. (Japan)*

Xaar 5601, a Thin Film PZT Si MEMS Inkjet Printhead for Industrial Applications, *Ramon Borrell, Xaar plc (UK)*

Increased Ink Space with Existing Thermal Inkjet Silicon and Printhead Modules Using Micro Pumping (Focal), *James Przybyla, Alex Govyadinov, and Nick McGuinness, HP Inc. (US)*

What Determines the Performance Limits of Piezo Inkjet Heads?, *Shinri Sakai, Yamagata University (Japan)*

Visualization of Ink Fluidity in Inkjet Imaging Process Using Method of Optical Coherence Tomography, *Yoshihiro Harada and Masataka Mohri, Ricoh Co., Ltd. (Japan)*

JIST-first On Plateau-Rayleigh Instability of a Cylinder of Viscous Liquid, *Leonid Pekker, FUJIFILM Dimatix (US)*

SPECIAL EVENT: CONFERENCE RECEPTION

Join colleagues for an evening of fun and networking aboard the historic August der Starke Paddle Steamer as we take a cruise and dine on the Elbe River.

Wednesday, September 26th
18:00 – 21:00

Higher Order Meniscus Oscillations and Small Droplets, *J. Frits Dijkstra, University of Twente, and Paul Duineveld, Philips Personal Health (the Netherlands)*

Meniscus Motion in Piezo-Drop on Demand Inkjet Printing, *Claudio Ravasio, Ioannis Menicou, and Stephen Hoath, Wolfson College Cambridge, and Peter Boltryk and Marko Dorrestijn, Xaar plc (UK)*

JST-first Particle Transport in Microchannels, *Leonid Pekker, FUJIFILM Dimatix (US)*

COLLEAGUE CONNECTIONS

Inkjet Open Forum

17:10 – 17:30

Join colleagues for an open discussion about the inkjet papers presented on Wednesday.

CONFERENCE RECEPTION

18:00 – 21:00

August der Starke Paddle Steamer

TRACK 2 3D PRINTING

10:20 – 17:30

Transport of Engineered Nanomaterials in Polyamide Powders, *James Stasiak, HP Inc., and Katrina Donovan, Oregon State University (US)*

Voxel-Level Materials Science: Selective Mechanical Property and Electronic Property Control within 3D Printed Parts Using Multi Jet Fusion, *Kristopher Erickson, Paul Olumbummo, Sterling Chaffins, Aja Hartman, Lihua Zhao, and Howard Tom, HP Inc. (US)*

Real-Time X-Ray Visualization of Penetration Dynamics of Ink into Powder Bed for Binder Jetting Process (Focal), *Shin Mizutani and Daichi Yamaguchi, Ricoh Co., Ltd., and Takeshi Fujiwara, Masato Yasumoto, and Ryunosuke Kuroda, National Institute of Advanced Industrial Science and Technology (Japan)*

3D Printing of Wood—Inkjet Printing of a Lignin based Ink on Cellulose, *Mathieu Soutrenon, Gabriel Billato, and Fritz Bircher, iPrint/HEIA-FR and Thomas Geiger, EMPA (Switzerland)*

3D Printing with Xenon Flash Lamp, *Krzysztof Nauka, Seongsik Chang, Aja Hartman, and Lihua Zhao, HP Inc. (US)*

Permanence Testing of 3D-Printed Objects

WEDNESDAY MORNING KEYNOTE

Advances in Additive Manufacturing: The Evolution of HP Inc.'s Jet Fusion™ 3D Printing Technology

Cheryl MacLeod, HP Inc. (US)

Recent advances and innovations in 3D printing, digital fabrication, and additive manufacturing methods are disrupting the way we design, develop, manufacture, and commercialize new technologies and products. These disruptions are enabling improved efficiencies on the manufacturing floor and in making the vision of mass customization a reality. It is clear that the newest industrial revolution is already well underway. The next phase of the revolution will extend beyond fit, form, and finish and will involve designing and engineering the functionality of the finished part by controlling the fundamental physical properties of the materials digitally, in real time, and at molecular and atomic scales. In this next phase, designers and engineers will be able to select and tune the physical properties of individual voxels as easily as geometric attributes. Leveraging decades of research and expertise in precision mechanics, microfluidics and materials sciences, HP has developed a 3D printing technology that achieves this level of control and is already reinventing the digital fabrication and manufacturing paradigms. This presentation will provide an overview of the Jet Fusion™ technology, discuss how it has evolved since its introduction in 2016. The presentation will conclude with a vision of how voxel-scale engineering will help to define the future of 3D printing, additive manufacturing, and digital fabrication.

Subjected to Fade Testing with Outdoor Daylight and High-Intensity Fluorescent Illumination and Evaluated with a Multispectral Camera and Image Analysis System, *Henry Wilhelm, Wilhelm Imaging Research, Inc. (US) and Ryerson University (Canada)*

Development of a Closed-Loop Control System for the Movements of the Extruder and Platform of a FDM 3D Printing System, *Alvaro Jose Rojas Arciniegas and Manuela Cerón Viveros, Universidad Autonoma de Occidente (Colombia)*

High-Resolution 3D Printing at the Tip of Optical Fibres, *Richard Caulfield, Saja Aabith, Richard Colchester, Sacha Noimark, Anna David, Ioannis Papakonstantinou, Adrien Desjardins, and Manish Tiwari, University College London (UK)*

Additive Manufacturing of Optical Components, *Erik Beckert, Falk Kemper, Sophie Sauva, and Maximilian Reif, Fraunhofer IOF (Germany)*

WEDNESDAY AFTERNOON KEYNOTE

Industrial Applications of Inkjet Technologies

Rich Baker, Integrity Industrial Ink Jet Integration LLC (US)

Inkjet is a versatile, precision deposition process, that is increasingly finding utilization in industrial manufacturing of products. These usages range from traditional graphics, labels and date-coding, to more novel applications, such as, deposition of functional fluids (biological, pharmaceutical, electronic, etc.), 3D item fabrication, and the deposition of adhesives and coatings. Using his perspective as president and founder of one of the largest independent inkjet systems integrators in the United States, Baker highlights a few of these novel applications of inkjet, plus explore the challenges and barriers to implementation of inkjet into main stream manufacturing.

Wednesday Coffee Breaks sponsored by

IOP | Institute of Physics
Printing and Graphics
Science Group

Towards 3D Digital Printing of Micro-Electro-mechanical Systems, Ofer Fogel and Zvi Kotler, Orbotech, and Zeev Zalevsky, Bar-Ilan University (Israel)

CONFERENCE RECEPTION

18:00 – 21:00

August der Starke Paddle Steamer

TRACK 3

SECURITY PRINTING

10:20 – 16:30

The Smartphone as a Security Print Inspection

Tool, Alan Hodgson, Alan Hodgson Consulting Ltd. (UK), and Robert Ulichney, HP Labs, HP Inc. (US)

Extending the Reach of a Barcode-based Imaging Ecosystem, Matthew Gaubatz and Marie Vans, HP Inc., and Steven Simske, Colorado State University (US)

Authentication of 3D Printed Parts Using 3D Physical Signatures (Focal), Stephen Pollard, Guy Adams, Faisal Azhar, and Fraser Dickin, HP Labs (UK)

Information Embedding in 3D Printed Objects Using Metal-Infused PLA and Reading with Thermography, Piyarat Silapasuphakornwong¹, Chaiwuth Sithiwichankit², and Kazutake Uehira¹;
¹Kanagawa Institute of Technology (Japan) and
²Chulalongkorn University (Thailand)

CONNECTIONS FOR INNOVATION IN SECURITY PRINTING

The Fabrication Needs of Secured Print

16:30 – 17:30

The secured print industry needs a continuous supply of innovative features. Polymer printing, fluorescents, metallics and smartphone readable features are all in vogue at present and applications in 3D print are emerging. Come and join in the discussion about how we package the Printing for Fabrication technologies to be more accessible to the secured print audience and connect up the supply chain to bring these to market. We'll discuss features, materials, and ecosystems.

Improvements in the Image Quality of Thermally Printed Security Cards, Mark Mizen, HID Global (US)

Stable Inks Containing Upconverting Nanoparticles based on an Oil-in-Water Nanoemulsion, Jon Kellar, South Dakota School of Mines and Technology (US)

Functional Ink Formulation for Individualized Smart Tags, Liisa Hakola, VTT (Finland)

CONNECTIONS FOR INNOVATION IN SECURITY PRINTING

The Fabrication Needs of Secured Print

16:30 – 17:30

Thursday September 27, 2018

ALL TRACKS

CLOSING KEYNOTE

8:45 – 9:40

2018-2020—The Time to Go Industrial with Digital Packaging Production, Montserrat Peidró Insa, Heidelberger Druckmaschinen (Germany)

TECHNOLOGY NETWORKING EVENT

Late Breaking News

11:40 – 12:40

TECHNOLOGY TOURS

13:00 – 18:00

See page 2 for details

TRACK 1

INKJET PROCESSES II

10:00 – 11:40

Inkjet Printing on Three-Dimensional Freeform Objects, Olivier Bürgy, Raphael Rätz, and Fritz Bircher, iPrint/HEIA-FR (Switzerland)

Direct-to-Shape: Increasing the Throw Distance, Renzo Trip¹, Nick Jackson¹, Felix Steinchen², Volker

Till², and Werner Zapka¹; ¹Xaar plc (Sweden) and ²Till GmbH (Germany)

The Importance of Software in Managing and Maintaining Image Quality and Enabling New Industrial Inkjet Applications, Debbie Thorp, Global Inkjet Systems Ltd. (UK)

Printing of Dielectric and Conductive Patterns on Non-Planar Surfaces Using Dispensing and Inkjet, Robert Thalheim¹, Maxim Polomoshnov², and Ralf Zichner¹; ¹Fraunhofer ENAS and ²Technische Universität Chemnitz (Germany)

TRACK 2 PRODUCTION PRINTING

10:00 – 11:40

Modeling Printing System Relationships based on Weibull Distribution, Nikita Gurudath, Ricoh Americas Corporation (US)

Liquid Ink Development System for Production Printing Using Volatile Carrier Oil and Fine Toners, Nobuyuki Nakayama, Satoshi Tatsuura, Taichi Yamada, Toshihiko Suzuki, Takamaro Yamashita, and Osamu Ide, Fuji Xerox Company, Ltd. (Japan)

Permanent Charge Roller for Indigo Digital Presses, Seongsik Chang, HP Inc. (US)

State-of-the-Art Printing Machine Technology, Takeshi Yoshikawa, Komori Corporation (Japan)

TRACK 3 SECURITY PRINTING II

10:00 – 11:40 AM

Near-Infrared (NIR)-to-NIR Upconversion Nanocrystals for Security-Printing and Forensic

THURSDAY KEYNOTE

2018-2020 – The Time to Go Industrial with Digital Packaging Production

Montserrat Peidró Insa, Heidelberger Druckmaschinen (Germany)

Due to the automated collection and analysis of user data, the customer approach has become more segment-orientated. As a result, go to the next supermarket and you will see how the variation of products is almost exploding, which has a strong impact on shorter runs and faster production cycles.

We live in a world where the question is not any longer if digital is the answer for packaging printing. Today the question is how to build a profitable business with it, which technology to select strategically and what to take into account to succeed.

Applications, Stanley May and Aravind Baride, University of South Dakota, and Jeevan Meruga, Jon Kellar, and William Cross, South Dakota School of Mines and Technology (US)

Printing Reflective Features for Security Printing, Rudy Ghosh, NovaCentrix (US)

Intrinsic Signatures for Forensic Identification of SOHO Inkjet Printers, Zhi Li, Wanling Jiang, Daulet Kenzhebalin, and Jan Allebach, Purdue University (US)

An Improved Image Denoising Algorithm in Wavelet Domain, Yingmei Zhou, Shanghai Publishing and Printing College, and Zhongmin Jiang, University of Shanghai Science and Technology (China)

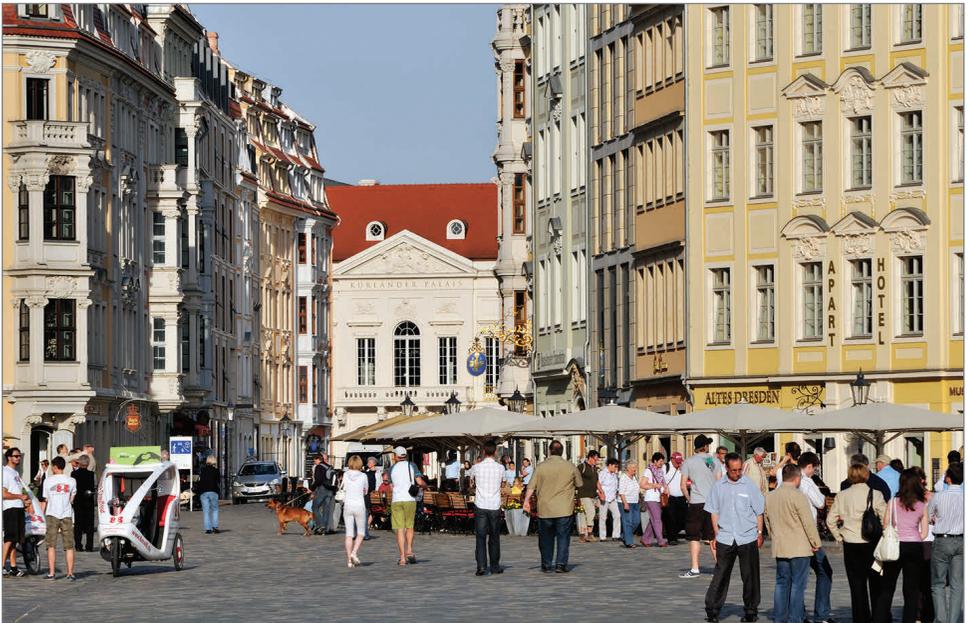


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Short Course Program

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 23, 2018

8:45 – 10:45

SC01: Role of Inkjet in Commercial and Industrial Printing Applications

Instructor: Ronald Askeland, HP Inc.

Track: Digital Printing Applications

Level: Overview

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 the 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 the 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 Advanced Technology and Platform Solutions division of HP in San Diego, where he has been since 2016. He has 33 years

Short Course Monitors are needed to help with classes. Monitors take courses for free. Interested? Contact Marion Zoretich at mzoretich@imaging.org for more information. Priority is given to students.

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. Previously he worked for HP in San Diego, CA (1984-2011) and Barcelona (2012-2015). Askeland is the author of Inkjet Print Engines in The Handbook of Digital Imaging (edited by Michael Kriss ©2015 John Wiley & Sons, Ltd.).

SC02: Let's Make an Inkjet Ink—Stabilizing Pigments and Dyes with Dispersants for Water-based (Textile) Inkjet Ink Applications

Instructor: Christian Maus, Evonik Corporation

Track: Inkjet Materials

Level: Introduction

This course focuses on the preparation of inkjet ink concentrates, starting with the pigment or dye and ending with the dispersant. It employs a practical approach to help students better understand the theory of particle stabilization, which in turn explains the role of dispersants in an ink.

The course content provides a clear explanation of a complex and intricate topic, while also diving into the most exciting inkjet sector in the current market: textile inkjet. It looks at the textile inkjet market, explores the key challenges facing formulators when working with dyes instead of pigments, and discusses how grinding equipment plays a vital role in the preparation of concentrates.

Benefits

This course enables an attendee to:

- Understand the basic chemistry and theory of stabilizing particles within a formulation.
- Determine the role and effect of a dispersant on an ink.
- Gain general understanding on the composition of an ink and how it is prepared.
- Gather information on the potential of textile inkjet, but also its hurdles.
- Provide first-hand experience, leaving the attendee motivated with greater inkjet knowledge.

Intended Audience: engineers, scientists, students, technical sales, and managers who want to refresh or gain knowledge in inks and additives used in inkjet inks, especially for the textile market.

Christian Maus is currently an ink market segment manager (focus on inkjet inks) for Evonik. He received his PhD at the University of Bonn (Germany) where he studied chemistry. Upon graduation, Maus launched his career in the coating and surface technology industry where he has resided for more than ten years. He also has a personal passion for scientific-related themes, as he and his colleagues recently achieved the first-place prize in a call-for-papers by the NPRI Association.

SC03: Industrial Inkjet: Applications, Challenges, and Considerations

Instructor: Rich Baker, Industrial Ink Jet Integration LLC

Track: Inkjet Technology

Level: Overview

Inkjet is finding increasing utility in industrial product manufacturing. The breadth and scope of these applications are wide, ranging from product decoration to product functionalization; additive to subtractive manufacturing; and flat items to direct to shape contour printing to 3D build processes. The applications may vary, but the general challenges and considerations to successfully assess, develop, and implement inkjet processes are universal. This course helps guide the attendee through the questions: What is inkjet? What chemistries can go through a print-head? Is inkjet right for my application? What are the development and design considerations? How to get going? Plus showcase a number of current and future applications of inkjet used in manufacturing.

Benefits

This course enables an attendee to:

- Understand inkjet technologies and limitations.
- Understand the chemistries/potential chemistries available.
- See the direction and challenges of using inkjet in industrial applications.
- Understand the potential strategic advantage of "Digital Manufacturing".

Intended Audience: those considering using inkjet in a manufacturing process (engineers, scientist, marketing, business development), as well as those generally interested in understanding the scope and strategic potential of inkjet in non-traditional applications.

Rich Baker received a PhD in chemistry at the University of Massachusetts. He has spent his entire career working on inkjet systems and applications, originally with Markem-Image, then FujiFilm Dimatix, and currently with Integrity

Industrial Ink Jet Integration. Integrity Integration designs, develops, and fabricates bespoke industrial print systems for industrial clients.

SC04: Introduction to 3D Inkjet Printing

Instructor: Sascha de Peña, HP Inc.

Track: 3D/Digital Fabrication Technology

Level: Introduction

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 equipments, performance, and materials are now making them a compelling alternative for a diverse range of applications, some of them unique. 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.

SHORT COURSES AT-A-GLANCE

	DIGITAL PRINTING APPLICATIONS	INKJET MATERIALS	INKJET TECHNOLOGY	3D/DIGITAL FABRICATION TECHNOLOGY
8:45 to 10:45	SC01: Role of Inkjet in Commercial and Industrial Printing Applications	SC02: Let's Make an Inkjet Ink — Stabilizing Pigments & Dyes w/Dispersants for Water-based (Textile) Inkjet Ink Apps	SC03: Industrial Inkjet: Applications, Challenges, and Considerations	SC04: Introduction to 3D Ink Jet Printing
11:00 to 13:00	NEW SC05: Printing Opportunities in Wearable Electronics	SC06: Inkjet Pigment and Dispersion Technology for Industrial Applications	SC07: Insight into New InkJet Technological Developments from Patent Literature	SC08: An Introduction to Digital Fabrication: Methods, Materials, and Applications
13:45 to 15:45	SC09: Digital Textile Printing: Applications, Markets, and Technology	NEW SC10: Practical Inkjet Ink Characterization	SC11: Fluid Dynamics and Acoustics of Piezo InkJet Printing	NEW SC12: Radiation Curing for 3D Printing
16:00 to 18:00	NEW SC13: Technology of Textile Printing	NEW SC14: Electron Beam Curing	NEW SC15: Modelling and Simulation of Flow-Induced Damage to Materials During Printing	NEW SC16: Adapting Functional Materials for Ink Jet Deposition

11:00 – 13:00

NEW SC05: Printing Opportunities in Wearable Electronics

Instructor: Alan Hodgson, Alan Hodgson Consulting Ltd.
Track: Digital Printing Applications
Level: Overview

The wearable electronics market is described in terms of a number of sectors including health care and clothing. This course outlines the benefits and opportunities that printing can bring to the fabrication of these devices, as an enabling technology for wide area wearable electronics. We examine the issues around the fabrication of textile electronics and sensor assemblies and where these devices fit into the concepts of the Internet of Things, Smart Cities, and Active Assisted Living.

The concepts are illustrated through case studies examining the field of personal protective equipment (PPE). The course shows how the relevant communities are coming together to address the remaining challenges within the forum of international standards.

Benefits

The course enables an attendee to:

- Understand wearable electronics market sectors and the relative attributes of these.
- Explain how wearable electronics fit into societal concepts like Smart Cities and Active Assisted Living.
- Gain insight into how printing for fabrication intersects with these market sectors.
- Understand the ways textile electronics and

PPE can be early adopters and opportunities for printed wearable devices.

- Evaluate how the relevant communities are coalescing around international standards activity and how this can be accessed.

Intended Audience: anyone with a basic knowledge of printing technologies. It aims to inform an audience ranging from students and engineers to market innovators and academics, and to help attendees assess the potential opportunities that the field of Wearable Electronics can bring to their career and/or job function

Alan Hodgson has 35 years experience across the printing industry and has been involved in printed electronics for more than 10 years, first in materials and later as a practitioner. He remains active in Printed Electronics as Chair of the International Standards committee IEC TC 119. He is a past President of IS&T and a long-term member of the conference committee for Printing for Fabrication. He is now active in the field of wearable electronics as an industrial consultant.

SC06: Inkjet Pigment and Dispersion Technology for Industrial Applications

Instructor: Alan Hudd, Alchemie Technology Ltd.
Track: Inkjet Materials
Level: Advanced/Specialist

This course describes the inkjet ink design process and requirements for successfully and reliably using a wide range of organic and inorganic pigments and of functional materials for inkjet print-

ing. Methods of pigment stabilization are discussed. Details of dispersion technology and DVLO theory are used to highlight the importance of chemically stabilizing the surfaces of pigment particles. The Stokes-Einstein equation describing Brownian motion and Stokes law describing gravitational settling are used to understand the inkjet pigment ink requirement for flocculation and not agglomeration. Practical examples of processing pigment dispersions and the types of chemical dispersants used in inkjet formulations are also presented.

Benefits

This course enables an attendee to:

- Understand the key challenges involved in preparing a pigment ink for use in inkjet printing.
- Appreciate DVLO theory.
- Consider the factors that influence long-term stability.

Intended Audience: material scientists, print professionals, and engineers interested in ink preparation.

Alan Hudd started an inkjet career with Domino before founding and managing Xenia Technology for 20 years. He is now cofounder and chairman of Alchemie Technology, which provides a wealth of industrial inkjet experience with a strong commercial awareness of the drivers and benefits of digital technology. Hudd has more than 30 years experience in the inkjet printing industry.

SC07: Insight into New InkJet Technological Developments from Patent Literature

Instructor: Mike Willis, Pivotal Resources, Ltd.

Track: Inkjet Technology

Level: Overview

There are around 300 new patent applications published each month that can give an insight into new inkjet-related developments. However searching for these patents, then filtering out the most interesting ones is time consuming. Willis has been following inkjet patents since the 1980s and regularly monitoring patent applications since 1997. This course reviews some of the developments that have occurred over the past 2 years, in particular encompassing printhead and system technology such as ink supplies, nozzle maintenance, and drop detection. The assessment includes thermal inkjet, Landa Digital, and other transfer processes; challenges for high-speed printing such as misting, condensation, and missing nozzle detection and correction; and new applications such as flooring, footwear, and cosmetics.

Benefits

This course enables an attendee to:

- Appreciate the value of the information contained within patent literature.
- Understand the limitations of patent research to avoid false interpretations.
- Understand and benchmark the state of the art in areas examined.
- Understand some of the issues being faced at the forefront of technology development.

Intended Audience: anyone interested in what inkjet developments are taking place that are not yet commercialized, such as scientists, engineers, and program and business development managers.

Mike Willis founded Pivotal Resources, a digital printing industry consultancy, in 1995. He has experience in a wide range of technologies and markets including drop-on-demand and continuous inkjet printing, electrophotographic technology, grayscale and color reproduction methods, and light sensitive materials. He was a founder member of Xaar—a spin-off company from Cambridge Consultants—and before that spent six years at Gestetner developing photocopiers. He graduated from the Polytechnic of Central London with an honours degree in photographic sciences.

SC08: An Introduction to Digital Fabrication: Methods, Materials, and Applications

Instructor: James W. Stasiak, HP Inc.

Track: 3D/Digital Fabrication Technology

Level: Introduction

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

Digital fabrication approaches are enabling new discoveries at the laboratory bench and providing new efficiencies and unprecedented product customization on the manufacturing floor. Digital fabrication methods—along with the development of “functional inks”—are making 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. It 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 fabrica-

tion 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 working or interested in digital fabrication and printed electronics.

Jim Stasiak is a distinguished technologist in HP Inc.'s 3D printing operations center in Corvallis, Oregon. His current responsibilities are leading the design and development of new printable materials, printing methods, processes, and applications. In a career spanning more than 30 years, he has made important contributions in the fields of condensed and soft matter physics, molecular electronics, nanotechnology, and inkjet-based digital fabrication. In recognition for his contributions and leadership in a wide range of digital printing science and technology he was the recipient of the 2012 IS&T Johann Gutenberg Prize. Stasiak has been an active member of IS&T; was instrumental in organizing and launching the inaugural Digital Fabrication Conference (2005), serving as the conference's General Chair in 2005, 2006, and 2017, and as the Executive Program Chair in 2015 and 2016. He is a named inventor on more than 50 issued US patents and is the author of numerous scientific and technical articles and book chapters.

13:45 – 15:45

SC09: Digital Textile Printing: Applications, Markets, and Technology

Instructor: Tim Phillips, IMI Europe Ltd.

Track: Digital Printing Applications

Level: Overview

The course reviews the exciting advances in digital textile printing using inkjet technology. It starts with an overview of the industry and its market dynamics, including the value chain and key players, as well as factors promoting and limiting its adoption. The course surveys the key digital textile printing application areas. For each application area and fabric type, the required ink, processing, and fix-

ing technology is reviewed. A more in depth discussion of ink technology, including colorants and formulation, with a comparison of dye-based and pigment printing, follows. Finally other aspects of digital printing of textiles, including printhead choice, fabric handling, printer configuration options, and print quality are presented.

Benefits

This course enables an attendee to:

- Gain an understanding of the main application areas contained within digital textile printing.
- Appreciate the market dynamics relevant to these application areas.
- Learn about the main ink, printing and processing technology required for digital textile printing, as well as some of the challenges and opportunities presented.

Intended Audience: technical, semi-technical, or business related job roles interested in the technology behind digital textile printing and what is causing the rapid growth in adoption.

Tim Phillips holds a degree in natural sciences from the University of Cambridge, a PhD from the University of Bristol, and an MBA from the University of Warwick. Previously Phillips was responsible for the textiles business at leading inkjet supplier Xennia Technology, recently acquired by Sensient Technologies. He is now managing director of IMI Europe, provider of inkjet conferences and courses, and founder of technology marketing consultancy Catenary Solutions.

NEW SC10: Practical Inkjet Ink Characterization

Instructor: Mark Bale, DoDxAct Ltd.

Track: Inkjet Materials

Level: Overview

Inkjet technology is being applied to a wide array of printing and fabrication challenges that are demanding fluids (inks) which encompass diverse materials and chemistries. This course looks at the ways these inks can be tested in a laboratory environment for application suitability to industrial processes, up to and including conducting exhaustive jetting experiments with different print heads and the challenges typically faced. The focus is in the practical use, rather than full explanation of the theory, of each test or measurement system described.

Benefits

This course will enable an attendee to:

- Learn about the demands of fluids for different applications.
- Understand the tools typically applied to non-jetted characterisation of fluid properties.

- Apply laboratory testing to screen ink formulations and discriminate the good from bad.
- See how to define laboratory-based jetting and printing experiments.
- Discover from real-life examples how jetting can be used to predict and solve issues.
- Apply the new learning to formulate their own testing methodologies.

Intended Audience: scientists, engineers, and R&D managers wanting to expand their understanding of the equipment and methods to reliably take inks from laboratory to the final application.

Mark Bale is a PhD Physicist (Birmingham, UK, 2001) with more than 15 years in industrial inkjet R&D ranging from ink formulation to print/deposition process prototyping and optimization using jetting and printing methods. Application experience includes OLEDs and photovoltaics, decorative surfaces, wide format graphics, labels and packaging, textiles, and bio-printing. Passionate about print heads and their uses, he now runs his own technical consultancy, helping organizations of all sizes maximize the potential of their inkjet-based developments.

SC11: Fluid Dynamics and Acoustics of Piezo InkJet Printing

Instructor: J. Frits Dijkstra, University of Twente
Track: Inkjet Technology
Level: Advanced/Specialist

Inkjet printing is all about depositing on demand droplets with well-defined volume and speed on a precisely given location on a substrate.

A piezo driven print head is an ensemble of closely-packed and highly-integrated micro channels, each channel partly covered with a piezoelectric actuator. Each channel acts as an acoustic cavity, of which the fluid dynamical and acoustical characteristics in the time and frequency domain determine the droplet generating characteristics of the print head.

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 is paid to non-linear effects related to the meniscus motion in the nozzle, inertia effects due to partly filling of the nozzle and droplet formation, 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 Dijkstra is emeritus 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.

NEW SC12: Radiation Curing for 3D Printing

Instructor: Donato Stanco, IGM Resins
Track: 3D/Digital Fabrication Technology
Level: Overview

Radiation curing technology began to be applied on an industrial level in the mid-1970s and it is still a growing technology, used globally in a wide range of market applications such as graphic arts, industrial coatings (on wood, plastic, metal, etc.), adhesives, and in the electronics world for both PCB and light functional coatings for LCD screens.

The last frontier of radiation curing today is within inkjet inks and 3D printing, both of which can benefit from the general advantages of radiation curing: VOC free, no need to evaporate water, fast “drying”, ecofriendly because of the lower energy consumption versus technologies that involve solvent/water evaporation, etc.

After more than 40 years radiation curing technology is still conquering market shares, which is the best demonstration of its competitiveness.

Benefits

This course enables attendees to learn the basics of radiation curing, including:

- radiation curing technologies: UV light, Electron beam (EB),
- UV lamps that are available on the market (mercury, LED)
- radiation UV available chemical kinetic mechanisms (radical and cationic) and their advantages/disadvantages
- raw materials (oligomers, monomers and photoinitiators), their main available chemical classes, and their properties to get final performances.

Intended Audience: R&D managers, R&D chemists, product managers who are absolute beginners in radiation curing.

Donato Stanco graduated in chemistry (bioorganic address) from the University of Milano, Italy. He has been

working with radiation curing for the past 25 years, as an R&D chemist and R&D manager in global companies that supply radiation curing coatings and printing inks. He is the inventor of some UV industrial coatings patents and was APAC and EMEA Area/Sales manager in companies selling UV raw materials. Currently he is a member of Technical Service Department at IGM Resin. He has given several lectures and seminars held on UV curing for food packaging by Radtech Association.

16:00 – 18:00

NEW SC13: Technology of Textile Printing

Instructors: Andreas Schönfeld and Enrico Sowade, Zschimmer & Schwarz Mohsdorf GmbH & Co. KG
Track: Digital Printing Applications
Level: Introduction and Overview

Over the past few years, inkjet printing of textiles has attracted increasing interest and the market is growing rapidly with an annual output of more than 1 billion m² of digitally printed textiles. Just as inkjet printing has become the dominant technology for ceramic tile decoration, it is thought that inkjet printing might also displace screen printing for textile applications. This course provides an introduction to digital textile printing covering textile materials, dyeing, markets, and chemical textile treatments—with the focus set on digital textile printing. The course also discusses the future of digital application of functional features for textiles such as flame retardancy, hydrophilic and hydrophobic surfaces, and catalytic pollutant degradation.

Benefits

This course enables an attendee to:

- Get an overview about textile materials and machinery.
- Discover and analyze the textile market structure, size, and market distribution.
- Learn the basics of textile dyeing and textile chemistry.
- Discover chemical pre- and post-treatments for textiles.
- Understand the fundamentals of textile inkjet inks and the interaction with the textile fibers.
- Explore potentially inkjet-printed functional features for textiles.

Intended Audience: beginners and advanced beginners, graduate students, engineers, scientists and managers interested in digital textile printing.

Andreas Schönfeld is the team manager of digital printing for the textile auxiliaries division of Zschimmer & Schwarz. He has worked at Zschimmer & Schwarz for 16 years holding various positions within the area of textile auxiliaries such as dyeing and printing, as well as textile applications

10% SAVINGS

Take 3 or more courses and get 10% off your total short course registration fee!

See registration form for details.

including the management of R&D projects. He graduated in textile technology from Chemnitz University of Technology (1993). After graduating, he worked as a dyehouse manager for an international textile company.

Enrico Sowade obtained his MA in print and media technology from Chemnitz University of Technology (2009). He has held different positions in the Department of Digital Printing and Imaging Technology at the University, completing his PhD (2017) in the field of functional inkjet printing. Sowade is currently working as R&D project manager for Digital Printing in the Textile Auxiliaries Division at Zschimmer & Schwarz. Based on multiple national and international cooperative research and development projects, he has many years of experience in the field of inkjet printing as digital manufacturing technology.

NEW SC14: Electron Beam Curing

Instructor: Mikala Baines, ebeam Technologies
Track: Inkjet Materials
Level: Overview

Electron beam (ebeam) technology is an alternative energy-curing method to cure inks and coatings for a variety of applications. It is particularly advantageous for printing on food packaging where safety is paramount, but also in applications that require tough, scratch-resistant coating, such as outdoor panels, wood panels, and décor.

Curing with ebeam enables printing on a wide range of materials including plastics, papers, heat sensitive substrates, and aluminum foils with a variety of printing applications including offset, flexo, and digital.

Electron beam technology can even go beyond printing and coating to create protective and luxury finishes such as OPV's, lamination, foiling, holographic effects, and haptic textures.

Benefits

This course enables an attendee to:

- Explore the industries in which electron beam technology is used.
- Learn how the technology works to cure inks and coatings and the parameters involved.
- Learn how much electron beam technology saves on operational cost.
- Understand the many benefits of using electron beam technology for printing on food packaging, particularly flexible packaging.

- Discover the range of existing printing presses incorporating electron beam technology.
- Learn how protective and luxury finishes can be created using electron beam curing.
- Trials with electron beam curing technology in order to learn more about the technology and how to use it to enhance their products and businesses.

Intended Audience: scientists (raw material and inks/coatings manufacturers), OEM's, printers, brand owners—anyone interested in improving performance, efficiency, and safety using electron beam inks and coatings.

Mikala Baines has more than 12 years of experience working in the printing industry. Most of these years involved formulating UV inkjet inks at Fujifilm in the UK. During this time, Baines also studied part-time to acquire her BSc in chemistry with the Open University. She has worked at ebeam Technologies, Switzerland, for 18 months as an applications development specialist for the Access ebeam Programme, which involves working with a wide range of companies to research solutions for their businesses and evaluating new possibilities for the technology.

NEW SC15: Modelling and Simulation of Flow-Induced Damage to Materials During Printing

Instructor: Etienne Rognin, University of Cambridge

Track: Inkjet Technology

Level: Overview

New applications of additive manufacturing such as printed electronics, biology, and pharmaceuticals draw the attention of industries and scientists to the development of novel, smart, functional, and sometimes even living ink formulations and materials. Nevertheless, there is a general lack of fundamental understanding of how the properties and functions of these materials can survive the harsh environment of large-scale industrial processes that were not originally designed for this purpose. This problem involves complex couplings between fluids and solids, molecular motions and process-scale flow, mechanics, and chemistry. This course is a didactic and example-based (flexible polymers in solutions, large proteins, and cells) review of current mathematical models and computational methods developed to tackle flow-induced damage during printing.

Benefits

This course enables an attendee to:

- Discover the rich field of flow-induced damage and chemistry.
- Estimate orders of magnitudes of deformation rates and fluid stress at each step of a printing process.

- Assess the importance of key physico-chemical parameters such as fluid viscosity, size, and concentration of dispersed/solvated compounds.
- Judge whether to resort to computer simulations.
- Use/adapt existing models to their own systems.

Intended Audience: scientists, engineers, chemists and biologists facing flow-induced damage challenges or seeking to broaden their knowledge of the science underpinning printing.

Etienne Rognin is a research associate at the University of Cambridge in the Fluids in Advanced Manufacturing Group. He received his engineering degree from the Ecole Centrale Paris and his PhD in fluid mechanics from the University of Grenoble, France. His research focuses on flow of complex fluids in practical applications from polymers in nanoimprint lithography to nuclear glass waste processing. He is currently investigating various mechanochemical processes activated by inkjet printing.

NEW SC16: Adapting Functional Materials for Ink Jet Deposition

Instructor: Clare Conboy, Printed Electronics Ltd.

Track: 3D/Digital Fabrication Technology

Level: Introduction

Inkjet printing is becoming increasingly widely adopted for applications outside traditional graphics printing. The ability to easily alter the image to be printed makes inkjet an attractive technique for one-off and short-run printing and consequently a good prototyping technique in the development of electronic circuits and 3D structures. As drops can be directed to specific target areas, it is also finding use in diagnostics, tablet manufacture, and biological-related activities on the one hand and in printing color filters or emissive polymers devices such as tv screens on the other. This course concentrates particularly on the formulation of material for deposition using inkjet printing.

Benefits

This course will enable an attendee to:

- Appreciate the types of materials that can be deposited by IJP.
- Understand some of the limitations imposed by the technique.
- Indicate whether a material might be suitable for depositing by IJP.
- Discern the basics of formulation for inkjet printing of functional materials.
- Distinguish between ejection properties and functional properties of an ink.
- Recognise the significance of processing methods and additives used in ink formulation.

Intended Audience: scientists and engineers interested in inkjet printing as a manufacturing technique; product managers with potential applications in additive manufacturing and ink formulation chemists moving into ink jet.

Clare Conboy works as a formulation scientist for Printed Electronics Ltd. Previously, she has worked for TTP, Plastic Logic, and Xaar, predominantly formulating inks for electronics and other materials deposition applications. She has more than 20 years of experience working with inks for a wide range of digital technologies. She has a BSc in chemistry from the University of Liverpool and a PhD in chemistry from the University of Kent.

CONFERENCE REGISTRATION + MEMBERSHIP OPTION

Register for the conference and become a member for the same rate as non-member registration.

See details, page 20.

Hotel and Travel Information

You couldn't find a more charming location to stay in Dresden. Walk out the Hilton Dresden and the painstakingly restored Residenzschloss/Dresden Royal Castle (now the Royal Palace Museum) is to your right and the infamous Dresden Frauenkirche (Church of Our Lady) is to your left. The river Elbe flanks the back of the hotel, while the charms of Dresden's old city are all in front of you. The Hilton Dresden hosts Printing for Fabrication 2018.

Hilton Dresden

An der Frauenkirche 5
01067, Dresden, Germany
+49-351-86420; +49-351-8642725 (fax)

Rate: Single €149/Double €174 includes wifi, breakfast, and VAT. City tax of 7% is not included in this rate, but is reimbursable, see conference website for details. Guests have access to the hotel fitness center free of charge; use of pool/sauna/whirlpool is €3/day.

Rate availability: Rates available 3 days before and after the conference dates based on availability. If you have a problem securing these days, please contact IS&T for help.

Early departure fee: A fee equal to one night + tax will be incurred for checking out prior to your confirmed departure date. Be sure to make any changes before checking in.

Check in/out: 14:00 pm/noon

Reservations Deadline: July 28, 2018

We are likely to sell out the hotel, so make your reservation as soon as possible.

Online reservation link:

<http://group.hilton.com/ABR-ISandT-2018>

Group name: ABR IS&T 2018

Room sharing service: IS&T has partnered with conferenceshare.co to help attendees find poten-



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tial roommates to reduce costs. Use of this service is at your discretion; IS&T assume no responsibility for decisions made as a result of using it. The meeting is listed as Print4Fab 2018 in the "select conference" tab. We appreciate your staying at the conference hotel, as doing so helps us keep registration costs down.

Travel Notes

Dresden International Airport is 10 km from the Hilton. There are direct flights from major German cities, as well as other European cities such as Amsterdam, Moscow, and Zurich. Travelers may want to transit through Frankfurt, or look at flights to Berlin or Prague. There ~22 trains/day between Berlin and Dresden, ranging from 1.75 to 2.5 hours. Between Prague and Dresden, there are ~17 trains ranging from 2.5 to 3 hours. There are also buses between each of the cities.

The Hilton Dresden website has detailed instructions on how to get to the hotel from the airport and the main train station.

Weather

September weather can range from 67°F/19°C to 52°F/11°C. Average rain: 8 days/month.

PRINTING FOR FABRICATION 2018 REGISTRATION

Register online at www.imaging.org/print4fab

First/Given Name _____

Last/Family Name _____

Title/Position _____

Company _____

Complete Mailing Address _____

Telephone _____ Fax _____

Email _____

Conference registration includes: admission to all technical sessions, including the Technologies in Digital Photo Fulfillment program; 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.**

Demonstration Session (see page 6 for details)

I would like a half-table to demonstrate a program/product related to the talk I am giving.*

(Session and Paper Title): _____

I am not an author, but would like information on reserving space to demonstrate a program/product*

Student and Young Professional Event (see page 3 for details)

I would like to take part in the Student and Young Professional Get Together. (You will be contacted with details closer to the event.)

Conference Registration (CHECK ONE)

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 conference registration options that include membership for the same price as a non-member fee. If you select a registration category with membership, please also choose between an online subscription to the Journal of Imaging Science and Technology (JIST) or Journal of Electronic Imaging (JEI).

	REGULAR		STUDENT	
	until Aug. 26	after Aug. 26	until Aug. 26	after Aug. 26
___ Conference registration: current IS&T/ISJ Member	\$795	\$895	\$160	\$210
___ Conf. registration (+ new or renewing membership + JIST)** Membership begins within 2 weeks of registration and expires 12/31/17.	\$895	\$995	\$185	\$235
___ Conf. registration (+ new or renewing membership + JEI)** Membership begins within 2 weeks of registration and expires 12/31/17.	\$895	\$995	\$185	\$235
___ Conference non-member registration	\$895	\$995	\$185	\$235
___ One-day: <input type="checkbox"/> Mon <input type="checkbox"/> Tues <input type="checkbox"/> Wed <input type="checkbox"/> Thurs	\$445	\$495	\$150	\$200
___ Short course only (check and proceed to short course selection area)				
___ Technologies in Digital Photo Fulfillment ONLY includes Welcome Reception (Sunday night) + all tech sessions Monday, but no proceedings book. TDPF proceedings will be available online for free download.	\$275	\$375	\$50	\$75

Registration Fee \$ _____

EXTRA COPY of Proceedings

Registration includes proceedings abstract book + full papers on USB flash drive. This is for additional copies.

Hardcopy proceedings book (full papers) _____ @\$125/each \$ _____

Extra abstract book + USB flash drive _____ @\$150/each \$ _____

Extra USB flash drive _____ @\$100/each \$ _____

Page Subtotal \$ _____

* You will be contacted by IS&T staff with further details.

** If you choose this option, you may register for Short Courses at the Member rate.

continued on next page

PRINTING FOR FABRICATION 2018 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 11 for course descriptions) **until Aug. 26** **after Aug. 26**

2-hour course Member registration	\$175	\$225	\$ _____
2-hour course Non-member registration	\$200	\$250	\$ _____
2-hour course Student registration	\$65	\$115	\$ _____
Check all that apply: <input type="checkbox"/> SC01 <input type="checkbox"/> SC02 <input type="checkbox"/> SC03 <input type="checkbox"/> SC04 <input type="checkbox"/> SC05 <input type="checkbox"/> SC06 <input type="checkbox"/> SC07 <input type="checkbox"/> SC08			
<input type="checkbox"/> SC09 <input type="checkbox"/> SC10 <input type="checkbox"/> SC11 <input type="checkbox"/> SC12 <input type="checkbox"/> SC13 <input type="checkbox"/> SC14 <input type="checkbox"/> SC15 <input type="checkbox"/> SC16			

OR

Take three or more classes and receive 10% 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 .90 to get your price, representing 10% savings; add additional lines if needed; students may not take advantage of this offer)

SC_____ \$ _____ + SC_____ \$ _____ + SC_____ \$ _____ = \$ _____ x .90 = \$ _____

Tour Registration (see page 2 for details; select only one tour) (Tour fees are non-refundable; includes box lunch)

___ From Pulp to Photo Cards: Felix Schoeller Group Weißenborn Paper Mill Tour	\$30	\$ _____
___ Smart Systems Campus in Chemnitz / Saxony Tour	\$30	\$ _____

Extra tickets for guest/spouse for receptions

___ Extra Welcome Reception Ticket (Name: _____)	\$45	\$ _____
___ Extra Conference Reception Ticket (Name: _____)	\$85	\$ _____

Membership (see also conference reg options)

US Address **Non-US Address**

new membership (begins now, expires 12/31/19)	\$95	\$105	\$ _____
annual membership renewal (expires 12/31/19)	\$95	\$105	\$ _____
student membership (begins now, expires 12/31/19)	\$25	\$25	\$ _____

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

join now and calculate fees based on member rates

Subtotal from previous page	\$ _____
Wire transfer fee, if applicable (\$25)	\$ _____
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 +1 703 642 9094. We do not encourage sending via e-mail.

Contact registration@imaging.org for wire transfer information.

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 Aug. 26, 2018. After that date, the cancellation fee is 50% of the total plus \$75.

No refunds will be given after September 23, 2018. All requests for refund must be made in writing.

Printing for Fabrication 2018 (NIP 34)



Society for Imaging Science and Technology
7003 Kilworth Lane
Springfield, VA 22151 USA
703/642-9090; 703/642-9094 (fax)

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