

Final Program and Proceedings of



**IS&T's NIP15:
International Conference on
Digital Printing Technologies**

October 17–22, 1999
Caribe Royale Resort Suites
Orlando, Florida

General Chair: Michael H. Lee
Publications Chair: David S. Weiss



IS&T

The Society for Imaging
Science and Technology

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The papers in this volume represent the program of NIP15: The International Conference on Digital Printing Technologies of the Society for Imaging Science and Technology held October 17–22, 1999 at the Caribe Royale Resort Suites, Orlando, Florida, USA.

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Introduction

Welcome to NIP15: International Conference on Digital Printing Technologies in Orlando, Florida. This is the fifteenth in IS&T's very successful series of NIP Conferences, the preeminent forum for discussions of advances and directions in the evolving and growing fields of non-impact and digital printing technologies. These Conference Proceedings include the final technical program, the full text of the papers and the presenters' brief biographical sketches. The contents are duplicated in CD-ROM format for your convenience. The NIP15 Conference Proceedings, along with the previous volumes, should serve as an increasingly important reference for technologists and others interested in the scientific and engineering concepts in non-impact and digital printing.

Conference participation is increasing. Over eighty companies and forty educational institutions are represented in over 190 technical presentations. A quarter of the papers includes affiliations that have not previously presented their work here. The international flavor of this Conference continues with contributions from twenty-one nations. 42% of the presentations are from North America, 22% from Europe and 36% from Asia/Japan.

The Conference's broadening scope reflects the increasing impact of digital printing and related fields into other areas. New sessions this year include Printing Systems - Engineering/Optimization, Specialty Printing Applications and Computer-to-Plate Technology. Toner-based marking and ink jet sessions continue as the backbone of this Conference. The popular media session remains strong. All but one session are scheduled in two parallel tracks arranged to avoid conflicts between related topics where possible. The third parallel track on Thursday and Friday features the Optoelectronic Imaging Materials and Devices session, which expands beyond the traditional photoreceptor topics to cover other optically active materials as well. A special Environmental session and panel discussion are held Tuesday afternoon to delve into this increasingly important area.

In response to attendee suggestions, the Conference is replacing the Poster Session with the Interactive Session, which includes advantages of both oral and poster presentations. The speaker provides a five-minute oral summary to the attendees. Then each continues his paper discussion at his display. This format gives the speaker the opportunity to highlight the key points of his paper to a large audience while focusing his detailed discussions to those most interested.

The popular tutorial program continues to grow with 26 topics plus a special hands-on workshop to use "The Ink Jet Printer as Home Creativity Machine." The Digital Textile Printing Forum and Exhibit as well as the Print Gallery are again held this year. Record participation in the Equipment Exhibit reflects what the attendees know well: this Conference provides a great opportunity to network and make connections.

We would like to extend special thanks to our colleagues on the Conference Committee and the IS&T staff for their dedication and hard work without which this Conference and Proceedings would not be possible. We also thank the authors for sharing their insight and knowledge. Such continuing efforts have helped elevate the NIP Conferences to their present status.

Michael H. Lee
General Chair

David S. Weiss
Publications Chair

The Schedule of Events

Sunday, October 17, 1999

8:00 am–12:00 pm	T1—Ink Jet Technology: 4-hour tutorial; Instructor: <i>Ross N. Mills</i>
8:00 am–12:00 pm	T2—Introduction to Electrophotography: 4-hour tutorial; Instructor: <i>Lawrence B. Schein</i>
8:00 am–1:00 pm	T3—Digital Printing in the Commercial Print Market (“Print for Profit”): 5-hour tutorial; Instructors: <i>Graham Galliford and John Michaelis</i>
8:00 am–5:00 pm	T4—Electronic Imaging System Fundamentals: 8-hour tutorial; Instructor: <i>Nitin Sampat</i>
1:00 pm–5:00 pm	T5—Paper and Printing: Overview of Paper Making, Paper Properties and Performance in Electrophotographic and Ink Jet Printing: 4-hour tutorial; Instructors: <i>Klaus Haarmann, Yuan Ling, and Mashiho Yuasa</i>
1:00 pm–5:00 pm	T6—Introduction to Toner Technology: 4-hour tutorial; Instructor: <i>George P. Marshall</i>
1:00 pm–5:00 pm	T7—Color Fundamentals for Color Reproduction: 4-hour tutorial; Instructor: <i>Gabriel Marcu</i>
2:00 pm–5:00 pm	T8—Digital Printing for the Home and Office: 3-hour tutorial, Instructors: <i>Graham Galliford and John Michaelis</i>
5:00 pm–7:00 pm	Welcome Icebreaker

Monday, October 18, 1999

8:00 am–8:50 am	Opening Remarks Keynote Paper—Digital High Volume Printing—Breakthrough for Print-on-Demand? <i>Arved Hübler</i>
9:00 am–12:00 pm	T9—The Physics of Electrophotographic Development, 3-hour tutorial, Instructor: <i>Larry Schein</i>
9:00 am–11:00 am	T10—Colorant Chemistry, 2-hour tutorial, Instructor: <i>C. Wayne Jaeger</i>
9:10 am–10:10 am	Track I—Printing Systems—Engineering/Optimization
9:10 am–11:40 am	Track II—Color Science and Image Processing
10:30 am–11:40 am	Track I—Ink Jet Processes
11:40 am–1:10 pm	Lunch Break (on your own)
1:00 pm–3:00 pm	T11—Electronic Characterization of Organic Pigments and Their Photoconducting Phenomena, 2-hour tutorial, Instructor: <i>Jin Mizuguchi</i>
1:10 pm–2:40 pm	Track I—Ink Jet Processes (continued)
1:10 pm–2:30 pm	Track II—Color Science and Image Processing (continued)
2:00 pm–5:00 pm	T12—Charging Systems and Dependent Processes in Electrophotography, 3-hour tutorial, Instructor: <i>Kenneth Pietrowski</i>
3:00 pm–5:30 pm	Track I—Interactive Session Printing Systems, Engineering/Optimization, Ink Jet Processes, and Ink Jet Materials
3:00 pm–5:30 pm	Track II—Interactive Session Color Science and Image Processing and Image Quality
3:30 pm–5:30 pm	T13—Modern Applications of Liquid Toner, 2-hour tutorial, Instructor: <i>George Gibson</i>

Tuesday, October 19, 1999

8:00 am–8:50 am	Keynote Paper—Management of Innovation in Large Corporations, <i>Rafik Loutfy</i>
8:00 am–12:00 pm	T14—Introduction to Digital Halftoning, 4-hour tutorial, Instructors: <i>Jan Allebach and Ping Wah Wong</i>
9:00 am–11:00 am	T15—Electrostatic Toner Transfer: Methods, Physics and Interactions, 2-hour tutorial, Instructor: <i>Thomas Tombs</i>
9:00 am–11:00 am	T16—Decision Theory: An Aid for Making Complex Decisions, 2-hour tutorial, Instructor: <i>George Gibson</i>
9:10 am–11:40 am	Track I—Ink Jet Materials
9:10 am–11:40 am	Track II—Print and Image Quality
11:40 am–1:10 pm	Lunch Break (on your own)

1:00 pm–3:00 pm	T17—Chemically Prepared Toner, 2-hour tutorial, Instructor: <i>George P. Marshall</i>
1:10 pm–2:30 pm	Track I—Ink Jet Materials (continues)
1:10 pm–2:30 pm	Track II—Print and Image Quality (continues)
1:00 pm–5:00 pm	T18—Advanced Topics in Digital Halftoning: 4-hour tutorial, Instructor: <i>Jan Allebach and Ping Wah Wong</i>
1:00 pm–5:00 pm	T19—Digital Color Management – Part I: 4-hour tutorial, Instructor: <i>Ed Giorgianni</i>
3:00 pm–4:10 pm	Track I—Speciality Printing Applications
3:00 pm–4:20 pm	Track II—Environmental Issues
4:20 pm–5:30 pm	Environmental Panel Discussion (immediately following Environmental Issues Session)
6:30 pm–8:30 pm	The Conference Reception

Wednesday, October 20, 1999

8:00 am–8:50 am	Honors and Awards
8:00 am–12:00 pm	T20—Digital Color Management – Part II, 4-hour tutorial, Instructor: <i>Ed Giorgianni</i>
8:00 am–12:00 pm	T21—An Overview of Ink Jet Printing from an Ink Perspective, 4-hour tutorial, Instructor: <i>Alan Hudd</i>
9:00 am–11:00 am	T22—Surface Tension, Wetting and Capillarity, 2-hour tutorial, Instructor: <i>Abraham Marmur</i>
9:10 am–11:40 am	Track I—Media for Digital Printing
9:10 am–11:40 am	Track II—Toner Based Marking: Processes
11:40 am–1:10 pm	Lunch Break (on your own)
1:00 pm–5:00 pm	T23—Digital Watermarking, 4-hour tutorial, Instructor: <i>Ed Delp</i>
1:00 pm–5:00 pm	T24—Color Quality in Desktop Printing, 4-hour tutorial, Instructor: <i>Gabriel Marcu</i>
1:00 pm–3:00 pm	T25—The Role of Pigment Dispersion in Controlling the Performance of Ink Jet Inks and Toners, 2-hour tutorial, Instructor: <i>Walter J. Wnek</i>
1:10 pm–2:30 pm	Track I—Media for Digital Printing (continues)
1:10 pm–4:00 pm	Track II—Toner Based Marking: Processes (continues)
3:00 pm–4:20 pm	Track I—Textile and Fabric Printing
3:15 pm–5:15 pm	T26—Fabrication Materials and Process of Ink Jet Printheads, 2-hour tutorial, Instructor: <i>Hue Le</i>
7:30 pm–9:30 pm	Digital Textile Printing Forum and Exhibit

Thursday, October 21, 1999

8:00 am–8:50 am	Keynote Paper—Current Status of Color Hardcopy Output Technologies, <i>Satoru Honjo</i>
9:10 am–10:10 am	Track I—Computer-to-Plate Technology
9:10 am–11:40 am	Track II—Toner Based Marking: Materials
9:10 am–11:40 am	Track III—Optoelectronic Imaging Materials and Devices
10:40 am–11:40 am	Track I—Digital Printing Instrumentation
11:40 am–1:10 pm	Lunch Break (on your own)
1:00 pm–4:00 pm	Workshop—The Ink Jet Printer as Home Creativity Machine, <i>Tom Ashley</i>
1:10 pm–2:30 pm	Track I—Thermal Printing
1:10 pm–2:30 pm	Track II—Toner Based Marking: Materials (continues)
1:10 pm–2:30 pm	Track III—Optoelectronic Imaging Materials and Devices (continues)
3:00 pm–5:30 pm	Track I—Interactive Session Digital Printing Instrumentation, Thermal Printing, Advanced and Novel Printing, Media for Digital Printing, Textile and Fabric Printing
3:00 pm–5:30 pm	Track II—Interactive Session Toner Based Marking: Materials, Liquid Toner Processes, Toner Based Marking: Processes
3:00 pm–5:30 pm	Track III—Interactive Session Optoelectronic Imaging Materials and Devices

Friday, October 22, 1999

8:00 am–12:00 pm	Track I—Advanced and Novel Printing
8:00 am–11:30 am	Track II—Liquid Toner Processes and Materials
8:00 am–11:40 am	Track III—Optoelectronic Imaging Materials and Devices (continues)

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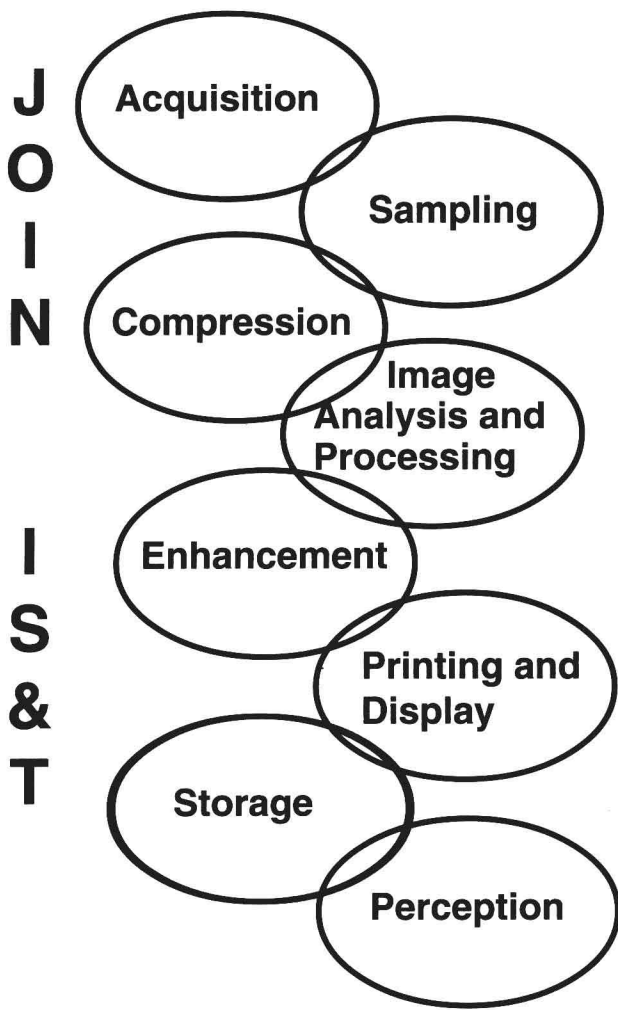
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The Papers Program

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Track I

Monday Morning, October 18, 1999—9:10 to 10:10 am

Printing Systems—Engineering/Optimization

*Session Chairs: John Stanton, The Technology Partnership plc and
Yee Ng, NexPress Solutions, L.L.C.*

9:10 am	Constraint Solving for Inkjet Print Mask Design Jonathan Yen, Hewlett Packard Laboratories, HP; Mats Carlsson, Swedish Institute of Computer Science; Michael Chang, Home Imaging Division, HP Joan Manel Garcia, IJBU-Barcelona, HP Hugh Nguyen, Internet Imaging Operation, HP, Hewlett Packard Laboratories, Palo Alto, California, <i>USA</i>	11
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Monday Morning, October 18, 1999—10:30 to 11:40 a.m.

Ink Jet Processes

*Session Chairs: Eiichi Suzuki, Canon Inc.; Michael Willis, Pivotal Resources Ltd;
and Ashok Murthy, Tektronix*

10:30 am	Focal paper—Wetting on Real Surfaces Abraham Marmur, Department of Chemical Engineering, Technion – Israel Institute of Technology, Haifa, <i>Israel</i>	22
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*Session Chairs: Eiichi Suzuki, Canon Inc.; Michael Willis, Pivotal Resources Ltd;
and Ashok Murthy, Tektronix*

1:10 pm	Xaar Greyscale Technology H. J. Manning and R. A. Harvey, Xaar Technology Limited, Cambridge, <i>England</i>	35
1:30 pm	Crosstalk Study of a High Speed Shear Mode Piezo Ink Jet Printhead Marlene McDonald, Yong Zhou, Spectra, Inc., Hanover, New Hampshire, <i>USA</i>	40
1:50 pm	New Bubble Jet Print Head for Photo-Quality Printing Mineo Kaneko and Hiroto Matsuda, Canon Inc., Kawasaki, Kanagawa, <i>Japan</i>	44
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2:40 pm	BREAK	

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Interactive Session

Consecutive five-minute oral previews will be followed by displays and
one-on-one discussions with the authors.

Printing Systems, Engineering/Optimization, Ink Jet Processes, Ink Jet Materials

*Session Chairs: Linda Creagh-Dexter, Spectra, Inc.; Hiromichi Noguchi, Canon, Inc.
and John Stanton, The Technology Partnership pcl*

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Tuesday Morning, October 19, 1999—9:10 to 11:40 a.m.

Ink Jet Materials

*Session Chairs: Eiichi Suzuki, Canon Inc.; Nigel Caiger, Coates Electrographics;
Linda Creagh-Dexter, Spectra, Inc.*

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10:30 am	Focal paper—The Effect of Extent of Cure of an Epoxy Adhesive in an Inkjet Printhead James M. Mrvos, Jeanne M. Saldanha Singh, and Sean T. Weaver, Lexmark, International Lexington, Kentucky, USA	106
11:00 am	Practical Considerations for Using UV Reactive Inks in Piezo DOD Printheads Richard J. Baker, Spectra Inc., Hanover, New Hampshire, USA	111
11:20 am	Oxygen Inhibition Effects in UV-Curing Inkjet Inks Nigel Caiger, Coates Electrographics, Bath, England Shaun Herlihy, Coates Lorilleux, Orpington, England	116

Tuesday Afternoon, October 19, 1999—1:10 to 2:30 p.m.

Ink Jet Materials (continues)

*Session Chairs: Eiichi Suzuki, Canon Inc.; Nigel Caiger, Coates Electrographics;
and Linda Creagh-Dexter, Spectra, Inc.*

1:10 pm	The Influence of Diluted Inks and Drying on the Lightfastness of Dye Based Ink-Jet Prints Stefan Schüttel and Rita Hofmann, ILFORD Imaging Switzerland GmbH, Marly, Switzerland	120
1:30 pm	Investigation of the Physical Properties of Some Pigmented Inks and their Mechanism of Dispersion Arup K. Basak and Henry M. Dante, Digital Printing Group; Research Development & Engineering, Philip Morris USA, Richmond, Virginia, USA	124
1:50 pm	Reactive Ink System for Aqueous Ink Jet Printer Hiromichi Noguchi, Canon Inc., Kanagawa, Japan Satoru Fujii, Nagase Chemicals Ltd., Hyogo, Japan	129
2:10 pm	Polymer Emulsion-Based Ink Jet Colorant and Ink T. Tsutsumi, M. Sawada and Y. Nakano, Kao Corporation, Materials Development Research Laboratories, Wakayama, Japan	133
2:30 pm	BREAK	

Tuesday Afternoon, October 19, 1999—3:00 to 4:10 p.m.

Specialty Printing Applications

*Session Chairs: Hiromichi Noguchi, Canon Inc.; Will Eve, Cambridge Consultants Ltd.;
and Judith Auslander, Pitney Bowes*

3:00 pm	Application of Thermal Ink Jet Printing to Industrial Markets Dan Briley, Specialty Printing Systems, Hewlett-Packard Company, San Diego, California, USA	137
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3:20 pm	InkJet Printing for Mailing Applications Judith Auslander, Donald Mackay, and Claude Zeller, Pitney Bowes, Shelton, Connecticut, <i>USA</i> John C. Briggs and Ming-Kai Tse, QEA, Inc., Burlington, Massachusetts, <i>USA</i>	141
3:40 pm	<i>Focal paper</i>—Color Pigmented Ink Jet Inks: New Developments and New Applications Ray A. Work, III, DuPont Ink Jet Inks, Wilmington, Delaware, <i>USA</i>	149

Wednesday Morning, October 20, 1999—9:10 to 11:40 a.m.

Media for Digital Printing

Session Chairs: Masaru Kato, Oji Paper; Paul Adair, Brady Corp.

9:10 am	Assessment of Plain Paper Printability by Office Ink Jet Printers Lesley J. Barker, Gina M. Garro, and Cheryn A. Kwasnik, Cytec Industries Inc., Stamford, Connecticut, <i>USA</i> Kate Johnson, KDY Inc., Nashua, New Hampshire, <i>USA</i>	151
9:30 am	The Role of Dielectric Relaxation in Media for Electrophotography (I)—Modeling of Electrostatic Transfer Inan Chen and Ming-Kai Tse, QEA, Inc., Burlington, Massachusetts, <i>USA</i>	155
9:50 am	The Role of Dielectric Relaxation in Media for Electrophotography (II)—Imaging Electrostatic Non-uniformity in Paper Ming-Kai Tse, David J. Forrest, and Francis Y. Wong, QEA, Inc., Burlington, Massachusetts, <i>USA</i>	159
10:10 am	BREAK	
10:40 am	Novel Sub-Micron Silica Gels for Glossy, Ink-Receptive Coatings D. M. Chapman and D. Michos, GRACE Davison, a business unit of W. R. Grace & Co.-Conn., Columbia, Maryland, <i>USA</i>	164
11:00 am	Effect of Hydrogel Formation in IPN Type Inkjet Receiver Coatings on Print Quality and Storage Properties Steven Sargeant and Nathan Jones, Arkwright Inc., Fiskeville, Rhode Island, <i>USA</i>	169
11:20 am	Development of Paper having Micro-Porous Layer for Digital Printing Shuichi Maeda, Toru Nakai, Akira Nakamura, Masakazu Hakomori and Masaru Kato, Imaging Media Development Laboratory, Oji Paper Company, Tokyo, <i>Japan</i>	172

Wednesday Afternoon, October 20, 1999—1:10 to 2:30 p.m.

Media for Digital Printing (continues)

Session Chairs: Masaru Kato, Oji Paper; Paul Adair, Brady Corp.

1:10 pm	Thermal Lamination of Ink Jet Photo Papers Tom Graczyk and Boping Xie, Arkwright, Inc., Guilford, Connecticut, <i>USA</i>	176
1:30 pm	Bridging the Gap between Paper and Printing: A Perspective from the Paper Industry Paul Kallmes, M/K Systems, Inc., <i>USA</i> Dave Wolin, KDY, Inc., <i>USA</i>	181

1:50 pm	Light Fastness of Large Format Ink Jet Media John Wang, Tao Chen, Odette Glass and Steven J. Sargeant, Arkwright Inc., Fiskeville, Rhode Island, USA	183
2:10 pm	Influence of Polymer-Polymer Interactions on Properties of Ink Jet Coatings Khizyr Khoultchaev and Tom Graczyk, Arkwright, Inc., Guilford, Connecticut, USA	187
2:30 pm	BREAK	

Wednesday Afternoon, October 20, 1999—3:00 to 4:20 p.m.

Textile and Fabric Printing

Session Chairs: Marc Van Parys, Unitex and Wallace W. Carr, Georgia Institute of Technology

3:00 pm	Xerographic Printing of Textiles P. H. Pfromm, Institute of Paper Science and Technology, Atlanta, Georgia, USA W. W. Carr, F. L. Cook, L. Wang, S. Shi, and H. Yan, H. Park, School of Textile and Fiber Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA	192
3:20 pm	Pigmented Latex System for Ink Jet Printing on Textile Olivia Y. Tian, Encad Inc., San Diego, California, USA Wayne C. Tincher, Georgia Institute of Technology, Atlanta, Georgia, USA	196
3:40 pm	Ink Jet Resin-Pigment Printing of Silk Fabrics Wayne C. Tincher and Ruxim Yang, Georgia Institute of Technology, Atlanta, Georgia, USA	200
4:00 pm	Ink Jet Inks for Digital Printing Sarima Deverakonda, Trident International Inc., USA	203

Wednesday, October 20, 1999, 7:30 to 9:30 pm

Forum and Exhibit **Digital Textile Printing**

Forum Chair: Vince Cahill, IT Strategies

Panel Chair: Ray Work, DuPont

This Forum will provide a unique opportunity for the public free exchange of ideas, opinions and information on digital textile printing. Dr. Work will moderate the panel discussion focusing on digital textile ink issues. We will feature presentations by ink specialists from digital ink manufacturing companies. Then, the audience will have an opportunity to pose questions and offer ideas for discussion about ink and other digital printing issues. Mr. Cahill will organize the Exhibit of Digitally Printed Textiles to be on view before and during the Forum.