
Digital Image Capture and Associated System, Reproduction and Image Quality Technologies

Portland, Oregon, USA
7-10 April 2002
# Table of Contents

The Tutorial Program iv
Thank You Sponsors iv
The Conference Committee v
The Schedule of Events vi
Welcome to the Conference vii
IS&T Corporate Members viii
IS&T Board of Directors ix
CIPE Teacher Workshop and Student Research Contest x
The Technical Papers Program xi
  Track 1
  Track 2 xv
The Technical Papers 1

**Track 1**
- Applied Vision Models 1
- Image Quality Modeling and Psychophysics 53
- Image Quality Standards and Measurement 88
- Imaging Performance Evaluation 142

**Track 2**
- Digital Image Capture 156
- Digital Photography 172
- Optics for Digital Imaging 196
- Museum and Archive Imaging 209
- Digital Image Processing 215

Authors Index 261
IS&T’s 2002 PICS Conference

The Technical Papers Program

Track 1

Monday Morning, April 8, 2002, 8:15 am – Noon

Applied Vision Models Session
Session Chair: Scott Daly, Sharp Corporation (USA)

8:15 am Opening Remarks

8:30 am (Keynote Paper) Vision-Based Approaches to Digital Halftoning
Jeffrey B. Mulligan, NASA Ames Research Center (USA)

9:30 am Halftone Quality Evaluation Using Color Visual Models
Xiao-fan Feng, Jon Speigle and Atsuhisa Morimoto, Sharp Laboratories of America, Inc. (USA)

10:00 am IS&T Honors and Awards

10:30 am Coffee Break

11:00 am Visibility of Ink Dots as Related to Dot Size and Visual Density
Ming-Shih Lian, Qing Yu and Douglas W. Couwenhoven, Electronic Imaging Products, R&D, Eastman Kodak Company (USA)

11:30 am On Contrast Sensitivity in an Image Difference Model
Garrett M. Johnson and Mark D. Fairchild, Munsell Color Science Laboratory, Center for Imaging Science, Rochester Institute of Technology (USA)

Noon Lunch Break (on your own)

Monday Afternoon, April 8, 2002, 1:30 – 4:30 pm

Applied Vision Models Session (continued)
Session Chair: Scott Daly, Sharp Corporation (USA)

1:30 pm A Metric of Perceived Image Degradation Based on Foveal and Peripheral Visual Performance, Jian Yang and Michael E. Miller, Electronic Imaging Products, R&D, Corporate Design & Usability Eastman Kodak Company (USA)

2:00 pm A Wide Field, High Dynamic Range, Stereographic Viewer
Greg Ward, Exponent – Failure Analysis Assoc. (USA)

2:30 pm High Quality LCD Imaging System - Beyond 8 Bits
Yasuhiro Yoshida and Yoichi Yamamoto, Design Technology Development Center, IC Group, SHARP Corp. (Japan)

3:00 pm Coffee Break
### IS&T's 2002 PICS Conference

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:30 pm</td>
<td>Wavelet Analysis of Print Defects</td>
<td>Kevin D. Donohue and M. Vijay Venkatesh, University of Kentucky (USA); and Chengwu Cui, Lexmark International, Inc. (USA)</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>Beyond the Visual System: A Cognitive Model of Color Categorization and its Application to Color Image Quality</td>
<td>Serguei Endrikhovski, Eastman Kodak Company (USA)</td>
</tr>
</tbody>
</table>

#### Tuesday Morning, April 9, 2002, 8:00 am – Noon

**Image Quality Modeling and Psychophysics Session**

*Session Chair: Serguei Endrikhovski, Eastman Kodak Company (USA)*

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am</td>
<td><em>Keynote Paper</em> Image-Dependent Quality and Preference Control</td>
<td>Hiroaki Kotera, Department of Information and Image Sciences, Chiba University (Japan)</td>
</tr>
<tr>
<td>9:00 am</td>
<td>Preference in Image Quality Modeling</td>
<td>Karin Töpfer, Brian Keelan, Scott O’Dell, and Robert Cookingham, Eastman Kodak (USA)</td>
</tr>
<tr>
<td>9:30 am</td>
<td>Extending Image Quality Models</td>
<td>Peter G. Engeldrum, Imcotek (USA)</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>10:30 am</td>
<td>The Effect of Reduced Color Depth on the Color Reproduction of Web Images</td>
<td>Efthimia Bilissi, Ralph E. Jacobson, and Geoffrey G. Attridge, Imaging Technology Research Group, University of Westminster (United Kingdom)</td>
</tr>
<tr>
<td>11:00 am</td>
<td>Color Image Quality for Multi-Function Peripherals</td>
<td>Jon Y. Hardeberg, Gjøvik University College (Norway)</td>
</tr>
<tr>
<td>11:30 am</td>
<td>Predicting Multivariate Image Quality from Individual Perceptual Attributes</td>
<td>Brian W. Keelan, Eastman Kodak Company (USA)</td>
</tr>
<tr>
<td>12:00 Noon</td>
<td>Lunch Break (on your own)</td>
<td></td>
</tr>
</tbody>
</table>

#### Tuesday Afternoon, April 9, 2002, 1:30 – 4:00 pm

**Image Quality Standards and Measurement Session**

*Session Chair: Edul Dalal, Xerox Corporation (USA)*

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30 pm</td>
<td><em>Keynote Paper</em> Challenges in International Standardization of Image Quality Evaluation</td>
<td>Toshihiko Inagaki, Research &amp; Development Center, Document Products Company, Fuji Xerox Co., Ltd. (Japan)</td>
</tr>
<tr>
<td>2:30 pm</td>
<td>Measurement and Analysis of Color Registration Errors of Print Engines</td>
<td>William Kress, Minolta-QMS (USA); and Kate Johnson and Prashant Mehta, ImageXpert (USA)</td>
</tr>
</tbody>
</table>
IS&T’s 2002 PICS Conference

3:00 pm  Automating the Rank Order Test for Printing Quality Evaluation
Chengwu Cui and Shaun Love, Lexmark International, Inc. (USA); and
Laurence G. Hassebrook and Chun Guan, University of Kentucky (USA)

3:30 pm  Utilizing Flatbed Scanners To Measure Printer Motion Quality Error
Michael C. Mongeon, Edul Dalal, and Rene Rasmussen, Xerox Corporation (USA)

CIPE STUDENT POSTER SESSION
4:00 to 5:00 pm
Session Chair: Steve Moore, CIPE:
The Center for Image Processing in Education
Poster papers will be presented by Portland area secondary school students.

Wednesday Morning, April 10, 2002, 8:00 am – Noon

Image Quality Standards and Measurement Session (continued)
Session Chair: Ralph Jacobson, University of Westminster (England)

8:00 am  (Keynote Paper) Nonlinear Effect of Modulation on Image Quality
Peter G. J. Barten, Barten Consultancy (The Netherlands)

9:00 am  An Objective Resolution Metric for Digital Printers
David Towner, Norman Burningham, and Eric Schneider, Hewlett-Packard Company (USA)

9:30 am  Gloss Patch Selection Based on Support Vector Regression
Chunghui Kuo, Yee Ng and C. Jeffrey Wang, NexPress Solutions LLC. (USA)

10:00 am Coffee Break

10:30 am  Instrumental Analysis of Gloss and Micro-Gloss Variations in Printed Images
J. S. Arney and James Michel, Rochester Institute of Technology (USA); and
Klaus Pollmeier, George Eastman House (USA)

11:00 am  Modeling the Modulation Transfer Function of Various Imaging Devices
Sámiara Bouzit and Lindsay MacDonald, Colour & Imaging Institute,
University of Derby (United Kingdom)

11:30 am  Migration from Contrast Transfer Function to ISO 16067-1 Spatial Frequency Response
Troy D. Strausbaugh and Robert G. Gann, Hewlett Packard Company (USA)

12:00 Noon Lunch Break (on your own)
IS&T’s 2002 PICS Conference
Wednesday Afternoon, April 10, 2002, 1:30 – 3:00 pm

Image Performance Evaluation Session
Session Chair: Paul Kane, Eastman Kodak Company (USA)

1:30 pm  Effect of Gamma Correction in Discrete Imaging Systems upon Determination of MTF  142
R. Jenkin, R. E. Jacobson, N. R. Axford, and E. Allen, Imaging Technology Research Group,
University of Westminster (United Kingdom)

2:00 pm  Enhanced Mottle Measurement  148
Dave Wolin, ImageXpert Inc. (USA)

2:30 pm  Variation and Calibration Error in Electronic Imaging  152
Peter D. Burns, Eastman Kodak Company (USA)
IS&T's 2002 PICS Conference

Track 2

Monday Morning, April 8, 2002, 8:15 am – Noon

Digital Image Capture Session

Session Chair: Paul De Keyser, Agfa Gevaert (Belgium)

8:15 am  Opening Remarks

8:30 am  (Keynote Paper) Small is Beautiful! Yes, But Also for Pixels of Digital Still Cameras? 156
Albert J.P. Theuwissen, Philips Semiconductors, and Delft University (The Netherlands)

9:30 am  They Said It Couldn't Be Done – System Design and Image Processing in the EFS-1 Electronic Film System 158
Matthew S. Whalen, Jon Stern, Itzhak Sapir, Chris Selstad, and William LaSor, SiliconFilm Technologies (USA)

10:00 am  IS&T Honors and Awards

10:30 am  Coffee Break

11:00 am  Measuring Scanner Dynamic Range 163
Dietmar Wueller, Image Engineering Dietmar Wueller (Germany)

11:30 am  Color Encodings: sRGB and Beyond 167
Kevin E. Spaulding, Eastman Kodak Company (USA); and Jack Holm, Hewlett-Packard Company (USA)

12:00 Noon  Lunch Break (on your own)

Monday Afternoon, April 8, 2002, 1:30 – 4:30 pm

Digital Photography Session

Session Chair: Dietmar Wueller, Image Engineering (Germany)

1:30 pm  Multi-Resolution Enhancement of Photographic Images 172
Koen Vande Velde and Paul A. Delabastita, Agfa-Gevaert N.V. (Belgium)

2:00 pm  Color Accuracy in ICC Color Management System 175
Huanzhao Zeng, Digital Printing Technologies, Hewlett-Packard Company (USA)

2:30 pm  Color Inconstancy Index: A Proposal and Case Study for Consumer Digital Cameras 181
Don Williams, Eastman Kodak Company (USA)

3:00 pm  Coffee Break

3:30 pm  Standard Reference Fulfillment Environments for the Management of Spatial Image Characteristics 185
Robert J. Parada, Jr. and Richard B. Wheeler, Eastman Kodak Company (USA)

4:00 pm  Refined Slanted-Edge Measurement for Practical Camera and Scanner Testing 191
Peter D. Burns and Don Williams, Eastman Kodak Company (USA)
IS&T's 2002 PICS Conference

Tuesday Morning, April 9, 2002, 8:00 am – Noon

Optics for Digital Imaging Session
Session Chair: Chris Dainty, Imperial College (England)

8:00 am Recent Developments in Adaptive Optics
J. C. Dainty, Blackett Laboratory, Imperial College (England)

8:30 am (Keynote Paper) A New Paradigm for Imaging Systems
W. Thomas Cathey and Edward R. Dowski, University of Colorado and CDM Optics, Inc. (USA)

9:30 am How Many Photons are There?
Russ Palum, Eastman Kodak Company (USA)

10:00 am Coffee Break

10:30 am (Keynote Paper) Smart Cameras Using The Logarithmic Asphere
Nicholas George and Wanli Chi, The Institute of Optics, University of Rochester (USA)

11:30 am Evolution of the Optics of the Modern Laser Printer
Larry Hubby, Hewlett-Packard Laboratories (USA)

12:00 Noon Lunch Break (on your own)

Tuesday Afternoon, April 9, 2002, 1:30 – 3:30 pm

Museum and Archive Imaging Session
Session Chair: Stephen Chapman, Harvard University (USA)

1:30 pm (Keynote Paper) Digitization vs. Photographic Duplication: Tone Reproduction, Image Quality, and Longevity Issues Relating to the Reformatting of Photographs in Cultural Institutions
Steven Puglia, National Archives and Records Administration (USA)

2:30 pm A Simplified Standard Method of Digital Image Tonal Capture for Archival Projects
Daniel L. Johnston, University of California (USA)

3:00 pm Successes and Failures: A Case Study of Implementing ICC Color Management Across Harvard University Art Museums
Peter Siegel, Harvard University Art Museums (USA)

CIPE STUDENT POSTER SESSION
3:30 to 5:00 pm
Session Chair: Steve Moore, CIPE: The Center for Image Processing in Education
Poster papers will be presented by Portland area secondary school students.
Digital Image Processing Session
Session Chair: Peter Anderson, Rochester Institute of Technology (USA)

8:00 am
A Multiprimary Display: Optimized Control Values For Displaying Tristimulus Values
Friedhelm König *, Kenro Ohsawa b,c, Masahiro Yamaguchi c, Nagaaki Ohyama b,c, and Bernhard Hill d
a) AGFA Corporation, Munich, Germany
b) Akasaka Natural Vision Research Center, Tokyo, Japan
c) Tokyo Institute of Technology, Tokyo, Japan
d) Aachen University of Technology, Aachen, Germany

8:30 am
Image Quality, Spatial Bandwidth, and Design Criteria for Optimum Digital Enhancement Techniques
Rodney Shaw, Hewlett Packard Research Laboratories (USA)

9:00 am
An Automatic Facial Feature Finding System for Portrait Images
Mark R. Bolin and Shoupu Chen, Eastman Kodak Company (USA)

9:30 am
Content-based Digital Watermarking using Contrast and Directionality
Nam-Deuk Kim and Alastair Reed, Digimarc Corporation (USA)

10:00 am Coffee Break

10:30 am
Web Image Processing Technology Based on Wavelet Formatted Images
Michael Thierschmann and Uwe Martin, LuraTech GmbH (Germany)

11:00 am
Reducing Patterns in the FM Part of Tile-Based Hybrid Screens
Rudi Bartels, Agfa Gevaert N.V. (Belgium)

11:30 am Lunch Break (on your own)

Wednesday Afternoon, April 10, 2002, 1:30 – 3:00 pm

Digital Image Processing Session (continued)
Session Chair: Anne Fry, Lifetouch (USA)

1:30 pm
Block Interlaced Pinwheel Error Diffusion
Pingshan Li, Sony Electronics Inc. (USA); and Jan P. Allebach,
School of Electrical and Computer Engineering, Purdue University, (USA)

2:00 pm
Stochastic Moiré II
Daniel L. Lau, Department of Electrical and Computer Engineering,
University of Kentucky (USA)

2:30 pm
Color Uniformity and Moiré in Dispersed Dot Halftone Masks Generated by Linear Pixel Shuffling
Peter G. Anderson, Jonathan S. Arney and Mark S. Guittard,
Rochester Institute of Technology (USA)