

**Image Processing, Image Quality, and
Image Capture Systems Conference
2022 (PICS 2002)**

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

**Portland, Oregon, USA
7-10 April 2002**

ISBN: 978-1-62276-644-4

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2002) by the Society for Imaging Science & Technology
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact the Society for Imaging Science & Technology
at the address below.

Society for Imaging Science & Technology
7003 Kilworth Lane
Springfield, Virginia 22151

Phone: 703-642-9090
Fax: 703-642-9094

info@imaging.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

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	
Track 1	xi
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

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)	1
9:30 am	Halftone Quality Evaluation Using Color Visual Models Xiao-fan Feng, Jon Speigle and Atsuhisa Morimoto, Sharp Laboratories of America, Inc. (USA)	5
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
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)	18
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)	24
2:00 pm	A Wide Field, High Dynamic Range, Stereographic Viewer Greg Ward, Exponent – Failure Analysis Assoc. (USA)	30
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)	35
3:00 pm	Coffee Break	

3:30 pm	Wavelet Analysis of Print Defects Kevin D. Donohue and M. Vijay Venkatesh, University of Kentucky (USA); and Chengwu Cui, Lexmark International, Inc. (USA)	42
---------	--	----

4:00 pm	Beyond the Visual System: A Cognitive Model of Color Categorization and its Application to Color Image Quality Serguei Endrikhovski, Eastman Kodak Company (USA)	48
---------	--	----

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

Image Quality Modeling and Psychophysics Session

Session Chair: Sergueri Endrikhovski, Eastman Kodak Company (USA)

8:00 am	<i>(Keynote Paper)</i> Image-Dependent Quality and Preference Control Hiroaki Kotera, Department of Information and Image Sciences, Chiba University (Japan)	53
---------	--	----

9:00 am	Preference in Image Quality Modeling Karin Töpfer, Brian Keelan, Scott O'Dell, and Robert Cookingham, Eastman Kodak (USA)	60
---------	---	----

9:30 am	Extending Image Quality Models Peter G. Engeldrum, Imcotek (USA)	65
---------	--	----

10:00 am Coffee Break

10:30 am	The Effect of Reduced Color Depth on the Color Reproduction of Web Images Efthimia Bilissi, Ralph E. Jacobson, and Geoffrey G. Attridge, Imaging Technology Research Group, University of Westminster (United Kingdom)	70
----------	---	----

11:00 am	Color Image Quality for Multi-Function Peripherals Jon Y. Hardeberg, Gjøvik University College (Norway)	76
----------	---	----

11:30 am	Predicting Multivariate Image Quality from Individual Perceptual Attributes Brian W. Keelan, Eastman Kodak Company (USA)	82
----------	--	----

12:00 Noon Lunch Break (on your own)

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

Image Quality Standards and Measurement Session

Session Chair: Edul Dalal, Xerox Corporation (USA)

1:30 pm	<i>(Keynote Paper)</i> Challenges in International Standardization of Image Quality Evaluation Toshihiko Inagaki, Research & Development Center, Document Products Company, Fuji Xerox Co., Ltd. (Japan)	88
---------	---	----

2:30 pm	Measurement and Analysis of Color Registration Errors of Print Engines William Kress, Minolta-QMS (USA); and Kate Johnson and Prashant Mehta, ImageXpert (USA)	94
---------	---	----

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)	99
3:30 pm	Utilizing Flatbed Scanners To Measure Printer Motion Quality Error Michael C. Mongeon, Edul Dalal, and Rene Rasmussen, Xerox Corporation (USA)	104

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	<i>(Keynote Paper)</i> Nonlinear Effect of Modulation on Image Quality Peter G. J. Barten, Barten Consultancy (The Netherlands)	109
9:00 am	An Objective Resolution Metric for Digital Printers David Towner, Norman Burningham, and Eric Schneider, Hewlett-Packard Company (USA)	115
9:30 am	Gloss Patch Selection Based on Support Vector Regression Chunhui Kuo, Yee Ng and C. Jeffrey Wang, NexPress Solutions LLC. (USA)	121
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)	126
11:00 am	Modeling the Modulation Transfer Function of Various Imaging Devices Samira Bouzit and Lindsay MacDonald, Colour & Imaging Institute, University of Derby (United Kingdom)	130
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)	136
12:00 Noon	Lunch Break (on your own)	

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 R. Jenkin, R. E. Jacobson, N. R. Axford, and E. Allen, Imaging Technology Research Group, University of Westminster (United Kingdom)	142
2:00 pm	Enhanced Mottle Measurement Dave Wolin, ImageXpert Inc. (USA)	148
2:30 pm	Variation and Calibration Error in Electronic Imaging Peter D. Burns, Eastman Kodak Company (USA)	152

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	<i>(Keynote Paper)</i> Small is Beautiful! Yes, But Also for Pixels of Digital Still Cameras? Albert J.P. Theuwissen, Philips Semiconductors, and Delft University (The Netherlands)	156
9:30 am	They Said It Couldn't Be Done – System Design and Image Processing in the EFS-1 Electronic Film System Matthew S. Whalen, Jon Stern, Itzhak Sapir, Chris Selstad, and William LaSor, SiliconFilm Technologies (USA)	158
10:00 am	IS&T Honors and Awards	
10:30 am	Coffee Break	
11:00 am	Measuring Scanner Dynamic Range Dietmar Wueller, Image Engineering Dietmar Wueller (Germany)	163
11:30 am	Color Encodings: sRGB and Beyond Kevin E. Spaulding, Eastman Kodak Company (USA); and Jack Holm, Hewlett-Packard Company (USA)	167
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 Koen Vande Velde and Paul A. Delabastita, Agfa-Gevaert N.V. (Belgium)	172
2:00 pm	Color Accuracy in ICC Color Management System Huanzhao Zeng, Digital Printing Technologies, Hewlett-Packard Company (USA)	175
2:30 pm	Color Inconstancy Index: A Proposal and Case Study for Consumer Digital Cameras Don Williams, Eastman Kodak Company (USA)	181
3:00 pm	Coffee Break	
3:30 pm	Standard Reference Fulfillment Environments for the Management of Spatial Image Characteristics Robert J. Parada, Jr. and Richard B. Wheeler, Eastman Kodak Company (USA)	185
4:00 pm	Refined Slanted-Edge Measurement for Practical Camera and Scanner Testing Peter D. Burns and Don Williams, Eastman Kodak Company (USA)	191

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)	196
8:30 am	<i>(Keynote Paper)</i> A New Paradigm for Imaging Systems W. Thomas Cathey and Edward R. Dowski, University of Colorado and CDM Optics, Inc. (USA)	199
9:30 am	How Many Photons are There? Russ Palum, Eastman Kodak Company (USA)	203
10:00 am	Coffee Break	
10:30 am	<i>(Keynote Paper)</i> Smart Cameras Using The Logarithmic Asphere Nicholas George and Wanli Chi, The Institute of Optics, University of Rochester (USA)	207
11:30 am	Evolution of the Optics of the Modern Laser Printer Larry Hubby, Hewlett-Packard Laboratories (USA)	208
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	<i>(Keynote Paper)</i> 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)	209
2:30 pm	A Simplified Standard Method of Digital Image Tonal Capture for Archival Projects Daniel L. Johnston, University of California (USA)	210
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)	214

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.

Wednesday Morning, April 10, 2002, 8:00 – 11:30 am

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 ^a , Kenro Ohsawa ^{b,c} , Masahiro Yamaguchia ^c , Nagaaki Ohshima ^{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	215
8:30 am	Image Quality, Spatial Bandwidth, and Design Criteria for Optimum Digital Enhancement Techniques Rodney Shaw, Hewlett Packard Research Laboratories (USA)	221
9:00 am	An Automatic Facial Feature Finding System for Portrait Images Mark R. Bolin and Shoupu Chen, Eastman Kodak Company (USA)	226
9:30 am	Content-based Digital Watermarking using Contrast and Directionality Nam-Deuk Kim and Alastair Reed, Digimarc Corporation (USA)	232
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)	237
11:00 am	Reducing Patterns in the FM Part of Tile-Based Hybrid Screens Rudi Bartels, Agfa Gevaert N.V. (Belgium)	241
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)	245
2:00 pm	Stochastic Moiré II Daniel L. Lau, Department of Electrical and Computer Engineering, University of Kentucky (USA)	250
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)	256