

Eighteenth Color and Imaging Conference

Color Science and Engineering Systems, Technologies, and Applications

FINAL PROGRAM AND PROCEEDINGS

November 8-12, 2010
San Antonio, Texas

Sponsored by

Society for Imaging Science and Technology

Society for Information Display



imaging.org



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Imaging Society of Japan (ISJ)

Royal Photographic Society of Great Britain (RPS)

Society of Motion Picture and Television Engineers (SMPTE)

Society of Photographic Science and Technology of Japan (SPSTJ)

CIC18 Technical Papers Program: Schedule and Contents

WEDNESDAY NOVEMBER 10, 2010

Welcome Remarks and Keynote

Session Chairs: Francisco Imai, Canon USA, Inc. and
Erno Langendijk, Philips CL-BU-TV
8:30 – 9:30 AM

Session sponsored by Canon USA, Inc.

Canon

8:30 **Advanced in Computational Photography**, Ramesh Raskar, MIT Media Lab (USA) *

Color in Displays

Session Chair: Anne Webster, Dolby Laboratories - Canada
9:30 – 10:30 AM

9:30 **The World Wide "Gamma"**, Nathan Moroney and Giordano Beretta, Hewlett-Packard Laboratories (USA) 1
9:50 **Toward an Automatic Color Calibration for 3D Displays**, Jérémie Gerhardt, Fraunhofer FIRST (Germany) and Jean-Baptiste Thomas, Gjøvik University College (Norway) 5
10:10 **Design Considerations for Wide Gamut Displays**, Karel Hinnen and Erno H. A. Langendijk, Philips Consumer Lifestyle (the Netherlands) 11

10:30 – 11:10 AM Coffee Break

Color in Illumination

Session Chair: Clément Fredembach,
Canon Information Systems Research Australia Pty., Ltd.
11:10 AM – 12:30 PM

11:10 **Colour from Grey by Optimized Colour Ordering**, Arash Vahdat and Mark S. Drew, Simon Fraser University (Canada) 17
11:30 **Sensor Transforms to Improve Metamerism-Based Watermarking**, Mark S. Drew, Simon Fraser University (Canada), and Raja Bala, Xerox Corporation (USA) 22
11:50 **A Color Target for Museum Applications**, Roy S. Berns and Marissa I. Haddock, Rochester Institute of Technology (USA) . . . 27
12:10 **Chromatic Flicker Perception in Human Peripheral Vision Under Mental Load**, M. Perz, D. Sekulovski, and M. Murdoch, Philips Research Europe (the Netherlands) 33

12:30 – 2:00 PM Lunch Break

*paper not available at time of publication

Future Color Imaging Scientists and Engineers Presentation and Panel Discussion

Session Chair: Mark Fairchild, Rochester Institute of Technology
2:00 – 3:30 PM

Session sponsored by Philips

PHILIPS

Stimulating Future Color Imaging Scientists and Engineers, Mark D. Fairchild, Rochester Institute of Technology (USA) 38

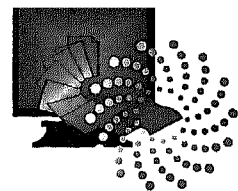
This 15-minute paper will be followed by a panel discussion, moderated by Mark D. Fairchild, featuring
Raja Bala, Xerox Corporation
Patrick Emmel, Clariant International, Ltd.
Phil Green, London College of Communications
Nathan Moroney, Hewlett-Packard Company
Sabine Süssstrunk, Ecole Polytechnique Fédérale de Lausanne
Shoji Tominaga, Chiba University

Interactive Papers Spotlight Session I: Color Perception and Evaluation

Session Chairs: Philipp Urban, Technische Universität Darmstadt, and Nicholas Bonnier, Océ Print Logic Technologies
3:30 - 4:00 PM

Two-minute previews of papers to be presented during Thursday afternoon's Interactive Paper Session.

Scaling Lightness Perception and Differences Above and Below Diffuse White, Ping-Hsu Chen, Mark D. Fairchild, and Roy S. Berns, Rochester Institute of Technology (USA) 42
Color Emotions from Two-Color Combinations with Various Area Ratios, Chanyang You and Youngshin Kwak, Ulsan National Institute of Science and Technology (South Korea) 49
Evaluating CATs as Predictors of Observer Adjustments in Softcopy Fine Art Reproduction, Jun Jiang, Franziska Frey, and Susan Farnand, Rochester Institute of Technology (USA) 54
Paper Whiteness and its Effect on Perceived Image Quality, Ludovic G. Coppel,^{1,2} Ole Norberg,² and Siv Lindberg¹; ¹Innventia AB and ²Mid Sweden University (Sweden) 62
Estimating Print Quality Attributes by Image Quality Metrics, Marius Pedersen¹, Nicolas Bonnier², Jon Y. Hardeberg¹, and Fritz Albrechtsen³; ¹Gjøvik University College (Norway), ²Océ Print Logic Technologies S.A. (France), and ³University of Oslo (Norway) 68
Validation of Quality Attributes for Evaluation of Color Prints, Marius Pedersen¹, Nicolas Bonnier², Jon Y. Hardeberg¹, and Fritz Albrechtsen³; ¹Gjøvik University College (Norway), ²Océ Print Logic Technologies S.A. (France), and ³University of Oslo (Norway) 74
A Reduced-Reference Method for Characterizing Color Noise in Natural Images Captured by Digital Cameras, Mikko Nuutinen¹, Olli Orenius², Timo Sämänen², and Pirkko Oittinen¹; ¹Aalto University and ²Helsinki University (Finland) 80



THURSDAY NOVEMBER 11, 2010

Measurement and Modeling of Chromatic Spatio-Velocity Contrast Sensitivity Function and its Application to Video Quality Evaluation, Keita Hirai, Toshiaki Mikami, Norimichi Tsumura, and Toshiya Nakaguchi, Chiba University (Japan) **86**

Testing Uniform Colour Spaces Using Printed Samples, Min Huang and Haoxue Liu, Beijing Institute of Graphic Communication (China); and M. Ronnier Luo and Guihua Cui, University of Leeds (UK) **92**

How Perceptually Uniform Can a Hue Linear Color Space Be?, Ingmar Lissner and Philipp Urban, Technische Universität Darmstadt (Germany) **97**

Riemannian Formulation of the CIEDE2000 Color Difference Formula, Dibakar R. Pani^{1,2}, and Ivar Farup¹; ¹Gjøvik University College (Norway) and ²University Jean Monnet (France) **103**

Vectorial Quality Measure for Digital Camera in Opponent FCS, Hiroaki Kotera, Kotera Imaging Laboratory (Japan) **109**

Evaluation of Color Differences: Use of LCD Monitor, Iris Sproew, Tobias Stamm, and Peter Zolliker, Swiss Federal Laboratory for Materials Testing and Research (EMPA) (Switzerland) **115**

4:00 – 4:30 PM Coffee Break

Perceiving Color

Session Chair: Jennifer Gille, Qualcomm QMT
4:30 - 5:50 PM

4:30 **Psychophysical and Psychophysiological Measurement of Image Emotion**, Joohee Jun¹, Li-Chen Ou¹, Boris Oicherman², Shuo-Ting Wei¹, M. Ronnier Luo¹, Hila Nachlieli³, and Carl Staelin³; ¹University of Leeds (UK), ²Sammy Ofer School of Communication, Herzliya Interdisciplinary Centre (Israel), and ³Hewlett-Packard Laboratories Israel (Israel) **121**

4:50 **Saliency, Visual Attention, and Image Quality**, Clément Fredembach, Jue Wang, and Geoff J. Woollfe, Canon Information Systems Research Australia Pty. Ltd. (Australia) . . . **128**

5:10 **Understanding the Gamma Adjustment of Images**, Jakkarin Singnoo and Graham D. Finlayson, University of East Anglia (UK) **134**

5:30 **Towards an Online Color Naming Model**, Dimitris Mylonas^{1,2}, Lindsay MacDonald¹, and Sophie Wuerger²; ¹London College of Communication and ²University of the Arts and School of Psychology, University of Liverpool (UK) **140**

EVENING PROGRAM

Session Chair: Francisco Imai, Canon USA, Inc.
7:30 – 8:30 PM

A Glass Bead Game: A Talk about Holography and Culture, Mark Holzbach, Zebra Imaging, Inc. (USA)
The Evening Talk will be followed by “Show Us Your Apps,” where attendees share their favorite Color- (and non-color-) Related Apps

Keynote

Session Chairs: Geoff J. Woollfe, Canon Information Systems Research Australia Pty. Ltd., and James A. Ferwerda, Munsell Color Science Lab/RIT
8:30 - 9:30 AM

8:30 **Ecological Valence and Human Color Preferences**, Stephen E. Palmer and Karen B. Schloss, University of California Berkeley (USA) **145**

Capturing Color

Session Chair: Sabine Süsstrunk, Ecole Polytechnique Fédérale de Lausanne
9:30 - 10:30 AM

9:30 **Still Photography Throwdown: Silver Halide vs. Silicon**, Mark D. Fairchild, Rochester Institute of Technology (USA) . . . **154**

9:50 **An Active Illumination Method for Tristimulus Image Display**, Shoji Tominaga, Takahiko Horiuchi, and Akihiko Yoshimura, Chiba University (Japan) **160**

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10:30 – 11:10 AM Coffee Break

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Session Chair: Ingeborg Tastl, Hewlett-Packard Co.
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11:10 **Image Color Mapping in Complex Log Space**, Hiroaki Kotera, Kotera Imaging Laboratory (Japan) **172**

11:30 **Motion Picture Versioning by Gamut Mapping**, Jürgen Stauder, Corinne Porée, Patrick Morvan, and Laurent Blondé, Technicolor Research & Innovation (France) **178**

11:50 **Constrained Pseudo-Brownian Motion for Image Enhancement**, Roberto Montagna and Graham D. Finlayson, University of East Anglia (UK) **184**

12:10 **Colour and Tolerance of Preferred Skin Colours**, Huanzhao Zeng, Hewlett-Packard Company (USA), and M. Ronnier Luo, University of Leeds (UK) **190**

12:30 – 2:00 PM Lunch Break

**Interactive Papers Spotlight Session II:
Spectral Color, Color Rendering, and Color Management**

Session Chairs: Philipp Urban, Technische Universität Darmstadt, and
Nicholas Bonnier, Océ Print Logic Technologies
2:00 – 2:30 PM

Two-minute previews of papers to be presented during
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Material-Based Object Segmentation Using Near-Infrared Information,
*N. Salamati and S. Süsstrunk, Ecole Polytechnique Fédérale de Lausanne
(Switzerland)* 196

Spectral Reflectance Reconstruction Based on Spatial Decomposition,
Zhen Liu and Xiaoxia Wan, Wuhan University (China) 202

Comparing LabPQR and the Spectral Gamut Mapping Framework,
*Maxim W. Derhak, ONYX Graphics Inc, and Roy S. Berns, Rochester
Institute of Technology (USA)* 206

**A Simplified Method of Predicting the Colorimetry of Spot Color
Overprints,** *Kiran Deshpande and Phil Green, London College of
Communication (UK)* 213

**Automatic Grouping of Semantic Keywords to Improve Image
Rendering,** *Albrecht Lindner¹, Nicolas Bonnier², Mehmet Candemir¹, and
Sabine Süsstrunk¹; ¹Ecole Polytechnique Fédérale de Lausanne (EPFL)
(Switzerland) and ²Océ - Print Logic Technologies S.A. (France)* 217

Analysis of Spatial Image Rendering, *John McCann, McCann Imaging
(USA); Vassilios Vonikakis, Democritus University of Thrace (Greece);
Carinna Parraman, University of the West of England (UK); and Alessandro
Rizzi, University of Milan (Italy)* 223

**Development of Precision Color Corrector for HDTV Single-chip Color
Broadcasting Camera,** *Hiroshi Shimamoto¹, Tomohiro Takahashi²,
Shingo Yamashita², Kohji Mitani², and Yasuhiro Ito¹; ¹NHK Engineering
Services, Inc., ²ASTRODESIGN Inc., and ³NHK (Japan)* 229

Unbounded Color Engines, *Marti Maria, Little CMS (Spain)* 234

Improving Perceptual Uniformity of Sampling in Color Look-up Tables,
Rohit A. Patil and Maxim W. Derhak, ONYX Graphics Inc. (USA) . . . 238

Using Image Quality Metrics to Evaluate an ICC Printer Profile,
*Kristyn Falkenstern^{1,2}, Nicolas Bonnier¹, Hans Brettle², Marius Pedersen³,
and Françoise Viénot^{4,5}; ¹Océ Print Logic Technologies S.A. (France),
²Télécom ParisTech, LTCI CNRS (France), ³Gjøvik University College
(Norway), ⁴Muséum National d'Histoire Naturelle (France), and ⁵Centre
de Recherche sur la Conservation des Collections (France)* 244

**New Color Encoding Method and RGB Primaries for Ultrahigh-Definition
Television (UHDTV),** *Seo Young Choi, Ho Young Lee, Yun Tae Kim, Ji
Young Hong, Du Sik Park, and Chang Yeong Kim, Samsung Electronics
(South Korea)* 250

The Rehabilitation of MaxRGB, *Brian Funt and Lilong Shi, Simon Fraser
University (Canada)* 256

G₀ Colorants, *Rodney L. Heckaman and Roy S. Berns, Rochester Institute of
Technology (USA)* 260

Color Beyond Flatland

Session Chair: Nathan Moroney, Hewlett-Packard Company
2:30 – 3:00 PM

2:30 **A Multiscale Analysis of the Touch-Up Problem,**
*James A. Ferwerda, Suparna Kalghatgi, and Benjamin Darling,
Rochester Institute of Technology (USA)* 266

2:50 **Color Styling Tools,** *Clement Shimizu and Gary W. Meyer,
University of Minnesota (USA)* 272

INTERACTIVE PAPERS SESSION

3:00 – 5:00 PM
Refreshments served

Session sponsored by Xerox Corporation



**CONFERENCE RECEPTION AND
RIVER WALK BOAT TOUR**

7:00 – 10:00 PM

FRIDAY NOVEMBER 12, 2010

Keynote and Cactus Award Presentation

Session Chair: Francisco Imai, Canon USA, Inc.
8:30 – 9:30 AM

Session sponsored by Hewlett-Packard Company



8:30 **The Challenge of our Unknown Knowns,** *Robert W.G. Hunt,
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Multi-Ink Printing

Session Chairs: Philipp Urban, Technische Universität Darmstadt and
Nicholas Bonnier, Océ Print Logic Technologies
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Values of Yule-Nielsen n,** *J.A. Stephen Viggiano, Rochester Institute
of Technology (USA)* 285

9:50 **Automatic Spot Color Matching Using In-line Densitometric
Measurements,** *Michal Aharon, Eyal Shelef, Doron Shaked,
Shlomo Harush, Tsafir Yedid-Am, Gregory Braverman, and
Pavel Blinchuk, Hewlett-Packard Laboratories (Israel)* 291

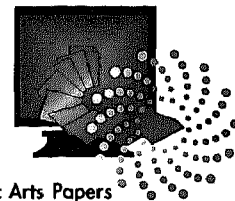
10:10 **Introducing Ink Spreading Within the Cellular Yule-Nielsen
Modified Neugebauer Model,** *Romain Rossier, Thomas Bugnon,
and Roger D. Hersch, Ecole Polytechnique Fédérale de Lausanne
(Switzerland)* 295

10:30 – 11:10 AM Coffee Break

A Spectrum of Clever Color Curiosities

Session Chair: Patrick Emmel, Clariant International, Ltd.
11:10 AM – 12:30 PM

11:10 **Revisiting Surface Colour Estimation Under Varying Illumination,**
*Graham D. Finlayson and Stuart E. Lynch, University of East Anglia
(UK)* 301



- 11:30 **Toward Reducing Observer Metamerism in Industrial Applications: Colorimetric Observer Categories and Observer Classification**, Abhijit Sarkar^{1,2}, Laurent Blondér¹, Patrick Le Callet², Florent Atrousseau², Patrick Morvan¹, and Jürgen Stauder¹; ¹Technicolor Research and ²IRCCyN-IVC, Polytech Nantes (France) **307**
- 11:50 **Color Scrambling for Secure Digital Content Distribution**, Peter Morovic, Ján Morovic, Michel Encrenaz, Jordi Vilar, and Jordi Arnabat, Hewlett-Packard Española (Spain) **314**
- 12:10 **Crosstalk Characterization of Stereoscopic 3D Display**, Sooyeon Lee and Youngshin Kwak, Ulsan National Institute of Science and Technology (South Korea) **318**

12:30 – 2:00 PM Lunch Break

Advanced Color Spaces

Session Chair: Graeme Gill, Argyll CMS
2:00 – 3:00 PM

- 2:00 **hdr-CIE LAB and hdr-IPT: Simple Models for Describing the Color of High-Dynamic-Range and Wide-Color-Gamut Images**, Mark D. Fairchild and David R. Wyble, Rochester Institute of Technology (USA) **322**
- 2:20 **Investigating Euclidean Mappings for CIEDE2000 Color Difference Formula**, Lorenzo Ridolfi, Marcelo Gattass, and Hélio Lopes, Pontifícia Universidade Católica do Rio de Janeiro (Brazil) **327**
- 2:40 **XYZ to ADL: Calculating Logvinenko's Object Color Coordinates**, Christoph Godau, Université Jean Monnet (France) and Brian Funt, Simon Fraser University (Canada) **334**

Controlling Color

Session Chair: Phil Green, London College of Communications
3:00 – 3:40 PM

- 3:00 **Appearance-based Image Splitting for HDR Displays**, Dan Zhang, James A. Ferwerda, and Jonathan B. Phillips, Rochester Institute of Technology (USA) **340**

- 3:20 **Measuring Anisotropic Light Scatter within Graphic Arts Papers for Modeling Optical Dot Gain**, Kathrin Happel, Marius Walter, Philipp Urban, and Edgar Dörsam, Technische Universität Darmstadt (Germany) **347**

3:40 – 4:10 PM Coffee Break

- 4:10 **Optimized Construction of ICC Profiles by Lattice Regression**, Eric Garcia and Maya Gupta, University of Washington (USA) **353**
- 4:30 **HANS – A New Color Separation and Halftoning Paradigm**, Ján Morovic, Peter Morovic, and Jordi Arnabat, Hewlett-Packard Española (Spain) **359**

Late Breaking News and MERL Best Student Paper Award Presentation

Session Chair: Joshua Pines, Technicolor
4:50 – 5:35 PM

- 4:50 **Local Contrast Enhancement Based on Adaptive Multi-Scaled Retinex Using Intensity Distribution of Input Image**, Tae-Hyoung Lee, Wang-Jun Kyung, In-Su Jang, and Yeong-Ho Ha, Kyungpook National University (South Korea) **365**
- 5:05 **Approach to CRI (Colour Rendering Index) for Full Colour RGB LED Source Lighting**, YungKyung Park, Ewha Womans University (South Korea) **371**
- 5:20 **Perception of Lighting Errors in Image Compositing**, James A. Ferwerda, Rochester Institute of Technology; Jeremy Selan, Cornell University; and Fabio Pellacini, Dartmouth College (USA) **375**

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