

PROCEEDINGS



Digital Photography IV

Jeffrey M. DiCarlo

Brian G. Rodricks

Editors

28–29 January 2008

San Jose, California, USA

Sponsored and Published by

IS&T—The Society for Imaging Science and Technology

SPIE

Volume 6817

Proceedings of SPIE, 0277-786X, v. 6817

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publishers are not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Digital Photography IV*, edited by Jeffrey M. DiCarlo, Brian G. Rodricks, Proceedings of SPIE-IS&T Electronic Imaging, SPIE Vol. 6817, Article CID Number (2008).

ISSN 0277-786X
ISBN 9780819469892

Copublished by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

and

IS&T—The Society for Imaging Science and Technology

7003 Kilworth Lane, Springfield, Virginia, 22151 USA
Telephone +1 703 642 9090 (Eastern Time) · Fax +1 703 642 9094
imaging.org

Copyright © 2008, Society of Photo-Optical Instrumentation Engineers and The Society for Imaging Science and Technology.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by the publishers subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/08/\$18.00.

Printed in the United States of America.

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

vii Conference Committee

SESSION 1 SENSOR DESIGN

- 6817 02 **An optimum design of the LOFIC CMOS image sensor for high sensitivity, low noise, and high full well capacity** [6817-01]
N. Akahane, W. Lee, S. Sugawa, Tohoku Univ. (Japan)
- 6817 03 **Electrical characterization of CMOS 1T charge-modulation pixel in two design configurations** [6817-02]
A. Tournier, STMicroelectronics (France) and Claude Bernard Univ. Lyon 1 (France); F. Roy, STMicroelectronics (France); G.-N. Lu, Claude Bernard Univ. Lyon 1 (France); B. Deschamps, STMicroelectronics (France)
- 6817 06 **Mitigation of pixel scaling effects in CMOS image sensors** [6817-05]
C. C. Fesenmaier, P. B. Catrysse, Stanford Univ. (USA)
- 6817 07 **Versatile method for optical performances characterization of off-axis CMOS pixels with microlens radial shift** [6817-06]
J. Vaillant, T. Decroux, E. Huss, F. Barbier, D. Hérault, F. Hirigoyen, N. Virolet, STMicroelectronics (France)

SESSION 2 NOISE SUPPRESSION

- 6817 08 **Novel method of Euclidean distance calculation for bilateral filtering based on CMOS sensor noise profiles** [6817-07]
R. Gheorghe, M. Aleksic, Advanced Micro Devices, Inc. (Canada); M. Smirnov, Mentor Graphics Corp. (USA)
- 6817 09 **Noise suppression approach with the BV- L_1 nonlinear image decomposition** [6817-08]
T. Saito, Y. Ishii, H. Aizawa, T. Komatsu, Kanagawa Univ. (Japan)
- 6817 0A **Noise reduction versus spatial resolution** [6817-09]
U. Artmann, D. Wueller, Image Engineering (Germany)
- 6817 0B **Profile based fast noise estimation and high ISO noise reduction for digital cameras** [6817-10]
Y. Yoo, H. Wey, S. Lee, C.-Y. Kim, Samsung Advanced Institute of Technology (South Korea)

SESSION 3 DEMOSAICKING, AUTO-FOCUS, AND WHITE BALANCING

- 6817 0C **Demosaicing method using the extended color total-variation regularization** [6817-11]
T. Saito, T. Komatsu, Kanagawa Univ. (Japan)

- 6817 0D **Fast and accurate auto focusing algorithm based on two defocused images using discrete cosine transform** [6817-12]
B.-K. Park, S.-S. Kim, D.-S. Chung, S.-D. Lee, C.-Y. Kim, Samsung Advanced Institute of Technology (South Korea)
- 6817 0E **WhitebalPR: automatic white balance by polarized reflections** [6817-13]
G. Fischer, K. Kolbe, M. Sajja, Cologne Univ. for Applied Sciences (Germany)

SESSION 4 IMAGE ENHANCEMENT

- 6817 0F **An approach to improve cell-phone cameras' dynamic range using a non-linear lens correction** [6817-14]
S. Goma, M. Aleksic, AMD (Canada)
- 6817 0G **Characterization and measurement of color fringing** [6817-15]
F. Cao, F. Guichard, H. Hornung, C. Sibade, DxO Labs. (France)
- 6817 0H **Stray light and shading reduction in digital photography: a new model and algorithm** [6817-16]
J. Wei, B. Bitlis, A. Bernstein, A. de Silva, Purdue Univ. (USA); P. A. Jansson, College of Optical Sciences/The Univ. of Arizona (USA); J. P. Allebach, Purdue Univ. (USA)

SESSION 5 IMAGE COMPRESSION

- 6817 0I **A survey on lossy compression of DSC raw data** [6817-17]
G. Fischer, D. Kunz, K. Köhler, Cologne Univ. for Applied Sciences (Germany)
- 6817 0J **Digital camera workflow for high dynamic range images using a model of retinal processing** [6817-18]
D. Tamburino, Ecole Polytechnique Fédérale de Lausanne (Switzerland); D. Alleysson, Univ. Pierre-Mendès-France (France); L. Meylan, S. Süsstrunk, Ecole Polytechnique Fédérale de Lausanne (Switzerland)
- 6817 0K **Efficient color coding for color filter arrays** [6817-19]
C. Lee, J. Lee, Yonsei Univ. (South Korea)

SESSION 6 SYSTEM ANALYSIS AND DESIGN I

- 6817 0L **Statistic analysis of millions of digital photos** [6817-20]
D. Wueller, Image Engineering Dietmar Wueller (Germany); R. Fageth, CeWe Color AG (Germany)
- 6817 0M **Mobile camera motion blur: not just a drunkard's walk** [6817-21]
T. J. Cooper, P. M. Hubel, Foveon, Inc. (USA)
- 6817 0N **A database of high dynamic range visible and near-infrared multispectral images** [6817-22]
M. Parmar, Stanford Univ. (USA); F. Imai, S. H. Park, Samsung Information Systems America (USA); J. Farrell, Stanford Univ. (USA)

SESSION 7 SYSTEM ANALYSIS AND DESIGN II

- 6817 0O **Using MTF data to simulate lens performance** [6817-23]
H. Eliasson, Sony Ericsson Mobile Communications (Sweden)
- 6817 0P **Spectral sensitivity optimization of color image sensor considering photon shot noise** [6817-24]
H. Kuniba, Nikon Corp. (Japan) and Rochester Institute of Technology (USA); R. S. Berns, Rochester Institute of Technology (USA)
- 6817 0Q **Does resolution really increase image quality?** [6817-25]
C.-L. Tisse, F. Guichard, F. Cao, DxO Labs. (France)
- 6817 0R **Sensor calibration and simulation** [6817-26]
J. Farrell, Stanford Ctr. for Image Systems Engineering (USA); M. Okincha, Vista Technologies (USA); M. Parmar, Stanford Ctr. for Image Systems Engineering (USA)

INTERACTIVE PAPER SESSION

- 6817 0S **Robust local restoration of space-variant blur image** [6817-27]
J. Lim, J. Kang, H. Ok, Samsung Advanced Institute of Technology (South Korea)
- 6817 0T **Sensor spectral sensitivities, noise measurements, and color sensitivity** [6817-28]
F. Cao, F. Guichard, H. Hornung, DxO Labs. (France)
- 6817 0U **Exposure preferences for digital still imaging: a psychophysical study** [6817-30]
J. Li, H. Hwang, R. Velarde, K. Atanassov, X. Jiang, R. Hsiu, Qualcomm Inc. (USA)
- 6817 0W **Chromatic coordinates in HDR image coding** [6817-32]
S. Bezryadin, KWE International, Inc. (USA); P. Burov, UniqueIC's (Russia); I. Tryndin, KWE International, Inc. (USA)
- 6817 0Y **Dynamic code block size for JPEG 2000** [6817-34]
P.-S. Tsai, Univ. of Texas-Pan American (USA); Y. LeCorne, Sigma Designs, Inc. (USA)
- 6817 0Z **Depth map from focus for cell-phone cameras** [6817-35]
R. Safaee-Rad, M. Aleksic, AMD (Canada)

Author Index

Conference Committee

Symposium Chair

Nitin Sampat, Rochester Institute of Technology (USA)

Conference Chairs

Jeffrey M. DiCarlo, Hewlett-Packard Laboratories (USA)
Brian G. Rodricks, Fairchild Imaging (USA)

Program Committee

Eiji Atsumi, Nokia Japan Company, Ltd. (Japan)
Peter B. Catrysse, Stanford University (USA)
Ted J. Cooper, Foveon, Inc. (USA)
Joyce E. Farrell, Stanford Center for Image Systems Engineering (USA)
Boyd A. Fowler, Fairchild Imaging (USA)
Michael A. Kriss, Consultant (USA)
Jingqiang Li, Qualcomm Inc. (USA)
Russel A. Martin, Foveon, Inc. (USA)
Kevin J. Matherson, Hewlett-Packard Company (USA)
John R. Reinert-Nash, Lifetouch, Inc. (USA)
Gloria G. Putnam, Eastman Kodak Company (USA)
Nitin Sampat, Rochester Institute of Technology (USA)
Sabine E. Süsstrunk, École Polytechnique Fédérale de Lausanne
(Switzerland)
Dietmar Wueller, Image Engineering (Germany)
Feng Xiao, Motorola, Inc. (USA)

Session Chairs

- 1 Sensor Design
Boyd A. Fowler, Fairchild Imaging (USA)
- 2 Noise Suppression
Peter B. Catrysse, Stanford University (USA)
- 3 Demosaicking, Auto-focus, and White Balancing
Joyce E. Farrell, Stanford Center for Image Systems Engineering (USA)
- 4 Image Enhancement
Ted J. Cooper, Foveon, Inc. (USA)

- 5 Image Compression
Michael A. Kriss, Consultant (USA)
- 6 System Analysis and Design I
Kevin J. Matherson, Hewlett-Packard Company (USA)
- 7 System Analysis and Design II
Brian G. Rodricks, Fairchild Imaging (USA)