

PROCEEDINGS OF SPIE

Novel Optical Systems Design and Optimization XVIII

G. Groot Gregory
Arthur J. Davis
Cornelius F. Hahlweg
Editors

10–12 August 2015
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 9579

Proceedings of SPIE 0277-786X, V. 9579

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Novel Optical Systems Design and Optimization XVIII, edited by G. Groot Gregory, Arthur J. Davis, Cornelius F. Hahlweg
Proc. of SPIE Vol. 9579, 957901 · © 2015 SPIE · CCC code: 0277-786X/15/\$18 · doi: 10.1117/12.2208531

Proc. of SPIE Vol. 9579 957901-1

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 publisher is 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 *Novel Optical Systems Design and Optimization XVIII*, edited by G. Groot Gregory, Arthur J. Davis, Cornelius F. Hahlweg, Proceedings of SPIE Vol. 9579 (SPIE, Bellingham, WA, 2015) Article CID Number.

ISSN: 0277-786X

ISBN: 9781628417456

Published 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

Copyright © 2015, Society of Photo-Optical Instrumentation Engineers.

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 SPIE 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/15/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print. Papers are published as they are submitted and meet publication criteria. A unique 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 as 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.

Contents

- v *Authors*
- vii *Conference Committee*
- ix *Introduction*

SESSION 1 NOVEL INSTRUMENTATION

- 9579 04 **Nonlinear multi-photon laser wave-mixing optical detection in microarrays and microchips for ultrasensitive detection and separation of biomarkers for cancer and neurodegenerative diseases [9579-1]**
- 9579 05 **A compact, efficient, and lightweight laser head for CARLO®: integration, performance, and benefits [9579-2]**
- 9579 06 **Multispectral digital holographic microscopy with applications in water quality assessment [9579-3]**
- 9579 07 **Concurrent fluorescence macro-imaging across multiple spectral regions in the visible and the near infrared [9579-4]**
- 9579 08 **Endoscopic system for automated high dynamic range inspection of moving periodic structures [9579-5]**

SESSION 2 NOVEL SYSTEMS

- 9579 0A **Dynamic noise corrected hyperspectral radiometric calibration in the SWIR range using a supercontinuum laser [9579-7]**
- 9579 0B **Risley Prism Universal Pointing System (RPUPS) [9579-8]**
- 9579 0C **Further development of imaging near-field scatterometer [9579-9]**
- 9579 0D **Object silhouettes and surface directions through stereo matching image processing [9579-10]**

SESSION 3 NOVEL DESIGN AND SIMULATION METHODS

- 9579 0E **Advancements in transformation optics-enabled gradient-index lens design [9579-11]**
- 9579 0F **Simulating optical system performance with three-dimensional scenes [9579-12]**

9579 OG **Curved fiber bundles for monocentric lens imaging (Invited Paper)** [9579-13]

SESSION 4 OPTIMIZATION

9579 OH **Optical transfer function optimization based on linear expansions** [9579-14]

9579 OI **Illumination system development using design and analysis of computer experiments**
[9579-15]

9579 OK **Design of three freeform mirror aplanat** [9579-17]

SESSION 5 NOVEL DISPLAY SYSTEMS

9579 OM **128-view autostereoscopic display** [9579-19]

9579 ON **Color and brightness uniformity compensation of a multi-projection 3D display** [9579-20]

9579 OP **Convertible 2D-3D display using an edge-lit light guide plate based on integral imaging**
[9579-22]

POSTER SESSION

9579 OQ **An optical filter with angular selectivity of the light transmission** [9579-23]

9579 OR **Analysis in the allocation of bandwidth applied to the concept of flexible optical networks**
[9579-24]

9579 OS **Design and verifications of an eye model fitted with contact lenses for wavefront
measurement systems** [9579-25]

9579 OT **Plenoptic camera based on a liquid crystal microlens array** [9579-26]

9579 OU **Performance analysis of NRZ, RZ, raised cosine and Gaussian modulation formats in 32x10
Gbps WDM system with different compensation techniques** [9579-27]

9579 OV **Enhanced and heralded single-photon source models for quantum applications** [9579-28]

9579 OW **Optical sensor for detection of the level of liquids or liquefied gases in tanks without the use
of moving parts** [9579-29]

9579 OX **Chemical resistance of optical plastics and resin for level detectors** [9579-30]

9579 OY **One-mirror and two-mirror optical scanners with variable focus lens** [9579-31]

9579 OZ **An optofluidic grism** [9579-33]

9579 IO **Analysis and compensation of moiré effects in fiber-coupled image sensors** [9579-34]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Aernouts, Ben, 0A
Agurok, Ilya P., 0G
Akiyama, Akira, 0D
Amaya, Ferney O., 0R
Amelard, Robert, 06
Arianpour, Ashkan, 0G, 10
Attia, Moez, 0V
Audenaert, Jan, 0I
Augello, Marcello, 05
Barbosa, Luiz C., 0W, 0X
Benitez, P., 0K
Brockner, Donovan E., 0E
Bruno, Alfredo E., 05
Calixto, Sergio, 0Z
Campbell, Sawyer D., 0E
Cattin, Philippe, 05
Chang, Rong-Jie, 0S
Chatta, Rihab, 0V
Chaves, Julio, 0K
Chen, Jia-Hong, 0S
Cheng, Yuan-Chieh, 0S
Clausi, David A., 06, 07
Deibel, Waldemar, 05
De Ketelaere, Bart, 0I
Deng, Zhengbiao, 0P
Dixon, John, 0B
Duncan, William J., 0F
Easum, John A., 0E
Emelko, Monica B., 06
Engel, James R., 0B
Fontes Garcia, Jonas, 0W, 0X
Ford, Joseph E., 0G, 10
Garnica, Guillermo, 0Z
Grabovickic, D., 0K
Gueddana, Amor, 0V
Hahlweg, Cornelius, 08, 0C
Haider, Shahid, 06, 07
Hetu, Marcel, 04
Hsu, Wei-Yao, 0S
Huang, Junejei, 0M
Infante, J., 0K
Iwabuchi, Manna, 04
Jin, Chao, 06, 07
Johnson, Adam R., 0G
Juergens, Philipp, 05
Karbasi, Salman, 0G, 10
Kazemzadeh, Farnoud, 06, 07
Keresztes, Janos C., 0A, 0I
Koshel, R. John, 0A, 0I
Kumagai, Hideo, 0D
LaReau, Chris, 0G
Lee, Jin-Ho, 0N
Lei, Yu, 0T
Ma, Xiaohui, 0P
Maxwell, Eric, 04
Mei, Yu, 06
Mellete, William M., 10
Mikš, A., 0Y
Miñano, Juan C., 0K
Ming, Hai, 0P
Mishra, Nivedita, 0U
Morrison, Rick, 0G
Motamedi, Nojan, 0G, 10
Nagar, Jogender, 0E
Nam, Dongkyung, 0N
Narasimhan, B., 0K
Nikolic, Milena, 0K
Novák, J., 0Y
Novák, P., 0Y
Omegna, Cicero L., 0W, 0X
Park, Du-Sik, 0N
Park, Juyong, 0N
Pescoller, Lukas, 0C
Pokorný, P., 0Y
Potter, Kevin, 0B
Pradel, Jean Sebastien, 04
Puche, William S., 0R
Ramos, Sashary, 04
Ramos-González, Roddy E., 0W, 0X
Rosete-Aguilar, Martha, 0Z
Rothe, Hendrik, 08
Saeys, Wouter, 0A, 0I
Saini, Simarjeet, 06
Sang, Hongshi, 0T
Schneider, Adrian, 05
Schwarze, Craig, 0B
Schwiegerling, Jim, 0F, 0H
Sierra, Javier E., 0R
Singh, Hardeep, 0U
Stack, Ron A., 0G
Stamenov, Igor, 0G
Tenill, Ryan, 0G
Tong, Qing, 0T
Tong, William G., 04
Torres, Ismael, 0Z
Uebeler, Denise, 0C
Vaillancourt, Robert, 0B
Wang, Anting, 0P

Wang, Chung-Yen, 0S
Wang, Pei-Jen, 0S
Wang, Shulu, 0P
Wang, Yuchang, 0M
Wang, Zi, 0P
Werner, Douglas H., 0E
Werner, Pingjuan L., 0E
Wong, Alexander, 06, 07
Xie, Changsheng, 0T
Zakirullin, Rustam S., 0Q
Zhang, Xinyu, 0T

Conference Committee

Program Track Chairs

José Sasián, College of Optical Sciences, The University of Arizona
(United States)

R. John Koshel, College of Optical Sciences, The University of Arizona
(United States)

Conference Chairs

G. Groot Gregory, Synopsys, Inc. (United States)

Arthur J. Davis, ORAFOL Display Optics (United States)

Cornelius F. Hahlweg, bbw Hochschule (Germany)

Conference Program Committee

Jost Adam, Christian-Albrechts-Universität zu Kiel (Germany) and
University of California, Los Angeles (United States)

Wenrui Cai, KLA-Tencor Corporation (United States)

Peter I. Goldstein, Philips Color Kinetics (United States)

Richard C. Juergens, Raytheon Missile Systems (United States)

R. John Koshel, College of Optical Sciences, The University of Arizona
(United States)

Scott A. Lerner, Carl Zeiss AG (Germany)

Paul K. Manhart, Optikos Corporation (United States)

Joseph R. Mulley, Melles Griot (United States)

Jorge Ojeda-Castaneda, Universidad de Guanajuato (Mexico)

Craig Olson, L-3 Communications (United States)

Jeffrey J. Perkins, Alpha Photonics, Inc. (United States)

Kevin P. Thompson, Synopsys, Inc. (United States) and The Institute of
Optics, University of Rochester (United States)

José Sasián, College of Optical Sciences, The University of Arizona
(United States)

David L. Shealy, The University of Alabama at Birmingham
(United States)

Haiyin Sun, ChemImage Corporation (United States)

Session Chairs

1 Novel Instrumentation
Joseph R. Mulley, Melles Griot (United States)

2 Novel Systems
Jeffrey J. Perkins, Alpha Photonics, Inc. (United States)

- 3 Novel Design and Simulation Methods
Cornelius F. Hahlweg, bbw Hochschule (Germany)
- 4 Optimization
R. John Koshel, The University of Arizona (United States)
- 5 Novel Display Systems
Arthur J. Davis, ORAFOL Display Optics (United States)

Introduction

This year in San Diego, California, we held the eighteenth conference of Novel Optical Systems Design and Optimization. The conference was very well attended and featured oral presentation topic tracks in: Novel Instrumentation, Novel Systems, Novel Design and Simulation Methods, Optimization and Novel Display Systems. In addition, there was also a poster session, a joint optical engineering plenary session and technical group events.

The conference started with Novel Instrumentation, which illustrated how novel instrumentation provides advantages in medical and life-science applications. Novel Systems included a number of advances in machine vision technology. The session on Novel Design and Simulation Methods was standing-room only, and the authors presented many interesting applications of computational optics. The session on Optimization covered some new approaches to design optimization, including topics in freeform optics. The final session on Novel Display Systems presented a range of progress from different technological approaches to glasses-free 3D displays.

An invited paper was presented by Dr. Salman Karbasi of the University of California, San Diego during the Novel Design and Simulation Methods session. Dr. Karbasi demonstrated a novel camera system that achieved a very wide angle field of view with high resolution by implementing an improved curved image surface fiber relay.

The Novel Optical Systems Design and Optimization committee continued to explore some new technology niches this year, and this seems to have been a successful and positive endeavor. We look forward to continuing this effort next year!

Our thanks go to those who helped make this conference a success, especially the authors, audience, SPIE staff, and program committee. The authors share the credit for making this conference an unqualified success. The audience built upon this success by being active and asking engaging questions. The SPIE staff ensured that everything ran smoothly before, during, and after the meeting. The program committee provided excellent assistance in ensuring high quality content, while also presiding over a number of sessions. The committee was composed of: Jost Adam, Wenrui Cai, Yi Chin Fang, Peter Goldstein, Richard Juergens, John Koshel, Scott Lerner, Paul Manhart, Joseph Mulley, Bharathwaj Narasimhan,

Jorge Ojeda-Castaneda, Craig Olson, Jeffrey Perkins, Jose Sasian, David Shealy, Hamilton Shepard, Haiyin Sun and Kevin Thompson.

Next year we will return for the nineteenth iteration of this conference. The chairs will be Arthur Davis and Cornelius Hahlweg. The planning for Novel Optical Systems Design and Optimization XIX in 2016 is already underway, so please start planning submissions, questions, and attendance. Focus themes are being decided at this time. If you would like to assist with the 2016 conference or other meetings in the future, please contact one of us. We look forward to seeing you in 2016!

Arthur J. Davis
G. Groot Gregory
Cornelius F. Hahlweg