PROCEEDINGS OF SPIE

Optical Systems Design 2015: Computational Optics

Daniel G. Smith
Frank Wyrowski
Andreas Erdmann
Editors

7–9 September 2015
Jena, Germany

Sponsored by
SPIE

Cooperating Organisations
European Optical Society (Finland)
Fraunhofer IOF (Germany)
Optonet (Germany)

Published by
SPIE

Volume 9630

Proceedings of SPIE 0277-786X, V. 9630

Optical Systems Design 2015: Computational Optics, edited by Daniel G. Smith, Frank Wyrowski, Andreas Erdmann, Proc. of SPIE Vol. 9630, 963001 · © 2015 SPIE
CCC code: 0277-786X/15/$18 · doi: 10.1117/12.2220819

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers 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 these proceedings:
Author(s), "Title of Paper," in *Optical Systems Design 2015: Computational Optics*, edited by Daniel G. Smith, Frank Wyrowski, Andreas Erdmann, Proceedings of SPIE Vol. 9630 (SPIE, Bellingham, WA, 2015) Six-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)
ISBN: 9781628418194

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

Printed in the United States of America.

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

SPIE. DIGITAL LIBRARY
SPIEDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a six-digit CID article numbering system structured as follows:

- 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.

Contents

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.

Conference Committee

Symposium Chair

Wilhelm Ulrich, Carl Zeiss AG (Germany)

Symposium Co-chairs

Juan Carlos Miñano, Universidad Politécnica de Madrid (Spain)
David M. Williamson, Nikon Research Corporation of America (United States)

Honorary Symposium Chair

Tina Kidger, Kidger Optics Associates (United Kingdom)

Conference Chairs

Daniel G. Smith, Nikon Research Corporation of America (United States)
Frank Wyrowski, Friedrich-Schiller-Univeristät Jena (Germany)
Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany)

Conference Programme Committee

Donis G. Flagello, Nikon Research Corporation of America (United States)
Ari T. Friberg, University of Eastern Finland (Finland)
Hans Peter Herzig, École Polytechnique Fédérale de Lausanne (Switzerland)
Olivier J. F. Martin, École Polytechnique Fédérale de Lausanne (Switzerland)
Ivan Richter, Czech Technical University in Prague (Czech Republic)
Jani Tervo, University of Eastern Finland (Finland)
Peter Török, Imperial College London (United Kingdom)
Michael Totzeck, Carl Zeiss SMT GmbH (Germany)
H. Paul Urbach, Technische Universitet Delft (Netherlands)
Wei Wang, Heriot-Watt University (United Kingdom)
Zeev Zalevsky, Bar-Ilan University (Israel)

Session Chairs

Keynote Session
Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany)

1 Imaging Applications I
Daniel G. Smith, Nikon Research Corporation of America (United States)

2 Optical Field Propagation Techniques
Daniel G. Smith, Nikon Research Corporation of America (United States)

3 Applications in Medicine and Energy Harvesting
Donis G. Flagello, Nikon Research Corporation of America (United States)

4 Non-Imaging Applications
Frank Wyrowski, Friedrich-Schiller-Universität Jena (Germany)

5 Imaging Applications II
Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany)

6 Electromagnetic Field Methods
Frank Wyrowski, Friedrich-Schiller-Universität Jena (Germany)

7 Inverse Imaging Problems
Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany)

8 Computational Optics
Andreas Erdmann, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany)

Introduction

In 2015, the name of our conference changed from Physical Optics to Computational Optics. This change was intended to help align the expectations of the authors and audiences with the interests of the organizers. We feel that the new name evokes something closer to the kinds of topics we want to learn about and share: the simulation of optical phenomena and systems using either novel techniques or by applying conventional techniques to develop new paradigm situations. Discussions with participants during and after the conference tended to support our decision to change the name.

This year's conference was filled with excellent speakers and an equally attentive audience that provided many questions and lively discussions. Our keynote talk by Donis Flagello was an historical overview of computation in lithography – a field that now depends heavily on computational optics for every cycle of development.

This was then followed by two and a half days of computational optics presentations, as well as had three posters presented on Tuesday. The eight regular sessions included: Imaging Applications (sessions 1 and 5), Optical Field Propagation Techniques (session 2), Applications in Medicine and Energy Harvesting (session 3), Non-imaging Applications (session 4), Electromagnetic Field Methods (session 6), Inverse Imaging (session 7), and Computational Optics (Session 8).

Daniel G. Smith
Frank Wyrowski
Andreas Erdmann