

PROCEEDINGS OF SPIE

Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV

Roland Winston
Sarah R. Kurtz
Editors

6–7 August 2017
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 10379

Proceedings of SPIE 0277-786X, V. 10379

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

Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV,
edited by Roland Winston, Sarah R. Kurtz, Proc. of SPIE Vol. 10379, 1037901
© 2017 SPIE · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2293160

Proc. of SPIE Vol. 10379 1037901-1

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 *Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV*, edited by Roland Winston, Sarah R. Kurtz, Proceedings of SPIE Vol. 10379 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

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

ISBN: 9781510612150
ISBN: 9781510612167 (electronic)

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 © 2017, 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/17/\$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**

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 seven-digit CID article numbering system structured as follows:

- The first five 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

v *Authors*
vii *Conference Committee*

SESSION 1 NEW CONCEPTS

10379 03 **How the Hilbert integral theorem inspired flow lines** [10379-4]

SESSION 2 SOLAR APPLICATIONS

10379 06 **Do we still care about CPV?** [10379-2]

10379 07 **Optical performance effects of the misalignment of nonimaging optics solar collectors** [10379-5]

10379 09 **Adaptive sensor-based ultra-high accuracy solar concentrator tracker** [10379-31]

SESSION 3 NUMERICAL AND FREEFORM METHODS

10379 0B **Testing light concentrators prototypes for the Cherenkov Telescope Array** [10379-8]

10379 0C **Synthesis of freeform refractive surfaces forming various radiation patterns using interpolation** [10379-9]

10379 0E **Efficiency of geometric designs of flexible solar panels: mathematical simulation** [10379-11]

SESSION 4 ILLUMINATION

10379 0G **Compact collimators designed with a modified point approximation for light-emitting diodes** [10379-13]

SESSION 5 ADVANCED DEVELOPMENTS

10379 0J **Advances on geometric flux optical design method (Invited Paper)** [10379-28]

10379 0K **Point to point multispectral light projection applied to cultural heritage** [10379-29]

10379 0L **Thermodynamic investigation of the segmented CPC** [10379-16]

SESSION 6 CONCENTRATOR DESIGNS

- 10379 ON **Tracking and shape errors measurement of concentrating heliostats** [10379-18]
- 10379 OP **Enhancing the light conversion efficiency in a luminescent solar concentrator by using a prism film** [10379-20]
- 10379 OQ **The characteristics of luminescent solar concentrators (LSCs) using inorganic phosphors** [10379-21]

POSTER SESSION

- 10379 OR **Optimization design of nonimaging Fresnel lens using total internal reflection prisms for sunlight concentration** [10379-22]
- 10379 OS **Numerical analysis of lateral illumination lightpipes using elliptical grooves** [10379-23]
- 10379 OT **Design and optimization of cascaded DCG based holographic elements for spectrum-splitting PV systems** [10379-24]
- 10379 OV **Optical coatings for luminescent solar concentrators** [10379-26]
- 10379 OW **Real time 3D photometry** [10379-30]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Apostoleris, Harry, 06
Arezki, Brahim, 0B
Brinkley, Jordyn, 09
Caliot, Cyril, 0N
Canabal, H., 0K
Ceballos-Herrera, Daniel E., 0R, 0S
Chen, Bing-Mau, 0Q, 0V
Chen, Jian-Wei, 0V
Chiesa, Matteo, 06
Chrysler, Benjamin, 0T
Chung, Min-Hsiu, 0P
Coquand, Mathieu, 0N
Enriquez-Torres, Delfino, 0E
Fernández-Balbuena, Antonio Álvarez, 0J, 0K, 0W
Ferry, Jonathan, 07
Galan, T., 0K
García-Botella, Ángel, 0J, 0K, 0W
Hassanzadeh, Ali, 09
Hassebo, Yasser, 0E
Hénault, François, 0B, 0N
Huang, Tsung-Wei, 0P
Jaing, Cheng-Chung, 0V
Jean, Pierre, 0B
Jiang, Lun, 03, 0L
Jocou, Laurent, 0B
Khélfifi, Bruno, 0B
Kostuk, Raymond K., 0T
Krizskiy, Pavel, 0C
Li, An-Ting, 0Q
Lin, Chia-Wei, 0P
Lu, Po-Chun, 0V
Luo, Tao, 0G
Magnard, Yves, 0B
Manigot, Pascal, 0B
Marciniak, Malgorzata, 0E
Martínez-Guerra, Edgar, 0R, 0S
Mayorga, S., 0K
Mazur, Iana, 0C
Muro, C., 0K
Olive, Jean-François, 0B
Pelaez, Silvana Ayala, 0T
Petrucci, Pierre-Olivier, 0B
Punch, Michael, 0B
Ricketts, Melissa, 07
Romo, J., 0W
Sánchez-Guerrero, Guillermo E., 0R, 0S
Serey-Roman, María Ignacia, 0E
Serrano, Ana, 0W
Stefancich, Marco, 06
Tseng, Hua-Yu, 0P
Vázquez-Molini, Daniel, 0J, 0K, 0W
Viera-González, Perla M., 0R, 0S
Voznesenskaya, Anna, 0C
Wang, Gang, 0G
Widyolar, Bennett, 0L
Winston, Roland, 03, 07, 0L
Wu, Yuechen, 0T
Xie, Jing-Han, 0V
Yang, Pao-Keng, 0P, 0V
Ying, Shang-Ping, 0Q
Yu, Wei-Gwo, 0V

Conference Committee

Conference Chairs

Roland Winston, University of California, Merced (United States)
Sarah R. Kurtz, University of California, Merced (United States)

Program Track Chairs

Oleg V. Sulima, GE Global Research (United States)
José Sasián, College of Optical Sciences, The University of Arizona
(United States)

Conference Program Committee

Pablo Benítez, CeDInt-UPM (Spain) and Light Prescriptions Innovators
LLC (United States)
William J. Cassarly, Synopsys, Inc. (United States)
Daniel Feuermann, Ben-Gurion University of the Negev (Israel)
Juan Carlos Miñano, CeDInt-UPM (Spain) and Light Prescriptions
Innovators LLC (United States)
Narkis E. Shatz, SureFire, LLC (United States)

Session Chairs

- 1 New Concepts
Lun Jiang, University of California, Merced (United States)
- 2 Solar Applications
Roland Winston, University of California, Merced (United States)
- 3 Numerical and Freeform Methods
Harry Apostoleris, Khalifa Institute of Science and Technology
(United Arab Emirates)
- 4 Illumination
Melissa N. Ricketts, University of California, Merced (United States)
- 5 Advanced Developments
Boaz Ilan, University of California, Merced (United States)
- 6 Concentrator Designs
Daniel Vázquez-Moliní, Universidad Complutense de Madrid (Spain)

