PROCEEDINGS OF SPIE

Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XVI

Roland Winston Eli Yablonovitch Editors

11–12 August 2019 San Diego, California, United States

Sponsored and Published by SPIE

Volume 11120

Proceedings of SPIE 0277-786X, V. 11120

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

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 XVI, edited by Roland Winston, Eli Yablonovitch, Proceedings of SPIE Vol. 11120 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510629332 ISBN: 9781510629349 (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 © 2019, 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 \$21.00 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/19/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

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



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

ADVANCED DEVELOPMENT

- 11120 02Practical challenges towards 50% efficient thermophotovoltaic energy conversion (Invited
Paper) [11120-1]
- Advances in Raman-based broadband optical refrigeration [11120-2]
- High concentration parabolic trough solar collector with novel secondary reflector in the vacuum receiver [11120-3]

CONCENTRATOR DESIGNS

11120 08 Implementation of a qualitative test for a Fresnel lens [11120-7]

NUMERICAL AND FREEFORM METHODS

- 11120 0ANumerical flowline concentrator design in 3D [11120-9]
- 11120 0BPushing the limits of beam-steering lens arrays [11120-10]
- 11120 OC Advances in flowline simulations (Invited Paper) [11120-11]

SOLAR APPLICATIONS

11120 0DNonimaging solar collectors toward net-zero GHG emission (Invited Paper) [11120-12]11120 0EAplanatic beam-down solar towers [11120-13]11120 0GBeyond the grid: the promise of solar concentration for non-electrical energy generation [11120-16]

NEW CONCEPTS

11120 OH	Simple analytical model for optical efficiency of an energy-harvesting projector [11120-17]
----------	---

ILLUMINATION

- 11120 0LImproved solar illumination collection using holographic light management techniques
[11120-21]
- Evolutionary optimization algorithms for nonimaging optical design [11120-22]

POSTER SESSION

- 11120 OP Optical design for LED illumination in application of implantable retinal prostheses [11120-25]
- 11120 0QEfficient and sustainable energy lighting solutions [11120-26]
- 11120 ORDevelopments for lighting applications by using prismatic film [11120-27]
- 11120 0SDesign and testing of a Fresnel mirror for solar energy [11120-28]