PROCEEDINGS OF SPIE

Environmental Effects on Light Propagation and Adaptive Systems IV

Karin Stein Szymon Gladysz Editors

13–17 September 2021 Online Only, Spain

Sponsored by SPIE

Cooperating Organisations
European Optical Society
EARSeL—European Association of Remote Sensing Laboratories (Germany)
ISPRS—International Society for Photogrammetry and Remote Sensing
CENSIS (United Kingdom)
SEDOPTICA

Supporting Organisation INEUSTAR/INDUCIENCIA (Spain)

Published by SPIE

Volume 11860

Proceedings of SPIE 0277-786X, V. 11860

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 *Environmental Effects on Light Propagation and Adaptive Systems IV*, edited by Karin Stein, Szymon Gladysz, Proc. of SPIE 11860, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510645646

ISBN: 9781510645653 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org

Copyright © 2021 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

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: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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

	ATMOSPHERIC TURBULENCE CHARACTERIZATION I
11860 04	Urban characteristics of the Monin-Obukhov similarity theory in the surface anisotropic layer of the atmosphere [11860-2]
11860 05	C-DIMM: an autonomous, outdoor and fixed seeing monitor for astronomy, atmospheric studies and free space optical communications [11860-3]
	ATMOSPHERIC TURBULENCE CHARACTERIZATION II
11860 07	Investigation of the atmosphere above the sea regarding laser performance [11860-6]
11860 08	Investigation of vertical profiles of optical turbulence from mesoscale simulations runs and radiosonde data [11860-7]
	LASER BEAM PROPAGATION AND FREE-SPACE OPTICAL COMMUNICATIONS
11860 09	Propagation of laser beams carrying orbital angular momentum through simulated optical turbulence in Rayleigh-Bénard convection (Invited Paper) [11860-8]
11860 OA	Demonstration of GBit/s coherent free-space optical communications over an 800 m outdoor path [11860-9]
11860 OC	Neural network classification of structured light in optical turbulence [11860-11]
11860 OD	Distortions of the non-paraxial Gaussian beam propagating through inhomogeneous atmosphere [11860-12]
	ADAPTIVE OPTICS
11860 OE	Hybrid adaptive optical system correcting turbulent distortions on the long atmospheric paths [11860-13]
11860 OG	Simulation of an optimized holographic wavefront sensor for realistic turbulence scenarios [11860-15]
11860 OH	Direct multiplexing of low order aberration modes in a photopolymer-based holographic element for analog holographic wavefront sensing [11860-16]

Dynamic interferometric wavefront sensor for strong turbulence conditions based on polarization imaging sensor [11860-17]