## PROCEEDINGS OF SPIE

# Optical Metrology and Inspection for Industrial Applications VIII

Sen Han Gerd Ehret Benyong Chen Editors

10–12 October 2021 Nantong, China

Sponsored by SPIE COS—Chinese Optical Society

#### Cooperating Organizations

Tsinghua University (China) • Peking University (China) • University of Science and Technology of China (China) • Zhejiang University (China) • Tianjin University (China) Beijing Institute of Technology (China) • Beijing University of Posts and Telecommunications (China) • Nankai University (China) • Changchun University of Science and Technology (China) • University of Shanghai for Science and Technology (China) • Capital Normal University (China) • Huazhong University of Science and Technology (China) • Beijing Jiaotong University (China) • China Jiliang University (China) • Shanghai Institute of Optics and Fine Mechanics, CAS (China) • Changchun Institute of Optics, Fine Mechanics and Physics, CAS (China) • Institute of Semiconductors, CAS (China) • Institute of Optics and Electronics, CAS (China) • Institute of Physics, CAS (China) • Shanghai Institute of Technical Physics, CAS (China) • China Institute of Physics, CAS (China) • Optical Society of Society of Korea (Korea, Republic of) • Australia and New Zealand Optical Society (Australia) • Optics and Photonics Society of Singapore (Singapore) • European Optical Society

#### Supporting Organizations

China Association for Science and Technology (CAST) (China) • Department of Information of National Nature Science Foundation, China (NSFC) (China)

Published by SPIE

#### Volume 11899

Proceedings of SPIE 0277-786X, V. 11899

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

Optical Metrology and Inspection for Industrial Applications VIII, edited by Sen Han, Gerd Ehret, Benyong Chen, Proc. of SPIE Vol. 11899, 1189901 © 2021 SPIE · 0277-786X · doi: 10.1117/12.2619290 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 Metrology and Inspection for Industrial Applications VIII, edited by Sen Han, Gerd Ehret, Benyong Chen, Proc. of SPIE 11899, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510646476 ISBN: 9781510646483 (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

#### SESSION 1 OPTICAL METROLOGY METHODS I

11899 04Frequency-domain-decomposition based white-light interferometry for noise-insensitive<br/>measurement [11899-3]

#### SESSION 2 OPTICAL METROLOGY METHODS II

- 11899 07 Absolute calibration of smooth surface and cylindrical surface measurement (Invited Paper) [11899-6]
- 11899 08 Simulation and error analysis of non-null interferometry for measuring high-order aspheric surface parameter errors [11899-7]
- 11899 09 Clear imaging specular surface and fringe patterns by using a concave mirror in phase measuring deflectometry [11899-8]
- 11899 0A Large thickness measurement of glass plates with a spectrally resolved interferometer using two positions of a reference surface and a compensation glass [11899-10]

#### SESSION 3 OPTICAL METROLOGY METHODS III

11899 0D A multimodal method for defect characterization of large-aperture optics (Invited Paper) [11899-13]

#### SESSION 4 OPTICAL METROLOGY METHODS IV

11899 OFA simplified two-phase differential decoding algorithm for high precision grating encoder<br/>[11899-14]11899 OGCooperative measurement accuracy evaluation method and software [11899-16]11899 OHIdentification of aliasing effects in measurements of unknown MTFs (Invited Paper) [11899-18]

#### SESSION 5 OPTICAL METROLOGY APPLICATIONS I

11899 OK Study on suppressing Doppler effect and non-linearity simultaneously in dynamic clearance measurement of frequency swept interferometry [11899-21]

#### 11899 0M The space solar radiation simulation technology for spacecraft vacuum thermal test [11899-23]

#### SESSION 6 OPTICAL METROLOGY APPLICATIONS II

- 11899 00 Mitigation of the impact of Doppler-frequency-shift in a coherent random modulation LiDAR via phase-coded subcarrier modulation [11899-25]
- 11899 0Q A wide-spectrum plug-and-play Fizeau interferometric system (Invited Paper) [11899-27]

#### POSTER SESSION

- 11899 0T **Optimization method of the laser beam for 3D precise measurement** [11899-30]
- 11899 0U A single-track absolute shaft encoding method [11899-31]
- 11899 0W Optimal inspection strategy planning for 3D geometric measurement based on laser scanning technique [11899-33]
- 11899 0X Film thickness measurement by double-wavelength infrared transmittance method [11899-34]
- 11899 OY Refractive index measurement based on multi-wavelength laser interferometer [11899-35]
- 11899 0ZResearch on aperture area measurement technique based on optical flux comparison method<br/>[11899-36]
- 11899 11 Stress-induced birefringence calibration of large aperture dynamic interferometer based on the rotation of light source polarization state [11899-38]
- 11899 12 On-line construction of dynamic control system in intelligent manufacturing [11899-39]
- 11899 13 Depth-of-focus extension in null interferometric microscopy for ICF capsule surface-defects detection [11899-40]
- 11899 14 Fringe projection profilometry with phase-coded optics [11899-41]
- 11899 15 High precision roundness measurement with two chromatic confocal sensors [11899-42]
- 11899 16 MEMS-mirror-based dynamic structured light projection system for three-dimensional measurement with high precision [11899-43]
- 11899 18 Long-term stability of LED filament standard lamps for total luminous flux [11899-45]
- 11899 1A Measurement of phase retardation and fast axis of a quarter-wave plate using vector beams and Fourier analysis [11899-47]

- 11899 1C **Research on the equal optical path interferometer** [11899-49]
- 11899 1DResolution-enhanced phase retrieval for fringe reflection technology with structured light<br/>illumination [11899-50]
- 11899 1EStatus of highly accurate flatness metrology at PTB for optics up to 1.5 meters in diameter<br/>[11899-9]