

PROCEEDINGS OF SPIE

Optical Metrology and Inspection for Industrial Applications VII

**Sen Han
Gerd Ehret
Benyong Chen**
Editors

**11–16 October 2020
Online Only, 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 Instrument and Control Society (China) • Japan Optical Society (Japan) • Korea Optical Society (Korea, Republic of) • Australia Optical Society (Australia) • Singapore Optical Society (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 11552

Proceedings of SPIE 0277-786X, V. 11552

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 SPIDigitalLibrary.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 VII*, edited by Sen Han, Gerd Ehret, Benyong Chen, Proceedings of SPIE Vol. 11552 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510639195

ISBN: 9781510639201 (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 © 2020, 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/20/\$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.

SPIE. DIGITAL LIBRARY

SPIDigitalLibrary.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

SESSION 1 OPTICAL METROLOGY METHODS I

- 11552 02 **Precision measurement methods of wavefront error for meter-size planar optical components applied to ICF systems (Invited Paper)** [11552-1]
- 11552 03 **FFT wavefront reconstruction algorithm with periodical extension for lateral shearing interferometry** [11552-2]
- 11552 04 **Micro-scale surface metrology using a large scanning range non-contact laser confocal microscope** [11552-3]
- 11552 06 **Dynamic fringe analysis using GPU assisted root-MUSIC method** [11552-75]

SESSION 2 OPTICAL METROLOGY METHODS II

- 11552 08 **Fast 3D surface defect detection with fringe projection** [11552-7]
- 11552 09 **Stereo phase unwrapping method based on feedback projection** [11552-8]

SESSION 3 OPTICAL METROLOGY METHODS III

- 11552 0D **Calibration of rotary encoders with different interfaces by means of laser dynamic goniometer** [11552-12]
- 11552 0E **Optical system design and measurement of freeform surface** [11552-13]
- 11552 0G **Polarization evolution of a vector optical field in a PT symmetry system** [11552-15]

SESSION 4 OPTICAL METROLOGY METHODS IV

- 11552 0H **Study of adjustment influence on the autocollimating null-indicator accuracy (Invited Paper)** [11552-16]
- 11552 0I **An experimental evaluation method for deformation measurement of large satellite antenna based on photogrammetry** [11552-17]
- 11552 0J **High precision stability measurement of large size structure using dual femtosecond frequency combs ranging system** [11552-18]

- 11552 OK **Large-area, uniform light field generated using a galvo scanning system for bi-directional reflectance distribution function measurement** [11552-19]
- 11552 OL **Investigation of temporally varying fringe pattern defects using machine learning for optical metrology** [11552-74]

SESSION 5 OPTICAL METROLOGY METHODS V

- 11552 OM **Optical profilometry of cylindrical openings for transparent objects (Invited Paper)** [11552-20]
- 11552 ON **Development of a standard device for laser scanner spatial performance calibration** [11552-21]
- 11552 OO **Optomechanical simulations of an advanced stitching interferometer set-up for large freeform optics** [11552-22]
- 11552 OP **Simulation research on ring source of Fizeau interferometer** [11552-23]
- 11552 OQ **Study of spatial frequency domain imaging technique for turbid media optical property estimation and application** [11552-24]

SESSION 6 OPTICAL METROLOGY APPLICATIONS I

- 11552 OS **An end-to-end speckle matching network for 3D imaging** [11552-26]
- 11552 OU **Human-computer interactive system development for cloud removal from single images** [11552-28]

SESSION 7 OPTICAL METROLOGY APPLICATIONS II

- 11552 OW **Turbine blade surface recovery based on photometric stereo** [11552-32]
- 11552 OX **The underwater active imaging detection with linear polarization (Invited Paper)** [11552-33]
- 11552 OY **Digital method for determining the vitreousity of malt barley** [11552-34]
- 11552 OZ **Recent advance on phase measuring deflectometry for obtaining 3D shape of specular surface (Invited Paper)** [11552-35]
- 11552 10 **Improved three-dimensional reconstruction model based on coaxial structured light system** [11552-36]
- 11552 11 **A method for judging faults of 3D body scanner based on standard sphere** [11552-38]

POSTER SESSION

- 11552 12 **A location error calibration method for multiple probing systems** [11552-40]
- 11552 13 **An improved device for the 3D optical scanner calibration and related influence factors on calibrating result** [11552-41]
- 11552 14 **Structured light fields 3D imaging with temporal phase unwrapping** [11552-42]
- 11552 15 **Design of control system for optical measuring device** [11552-43]
- 11552 16 **Design of wireless measurement and control system for interferometer** [11552-44]
- 11552 17 **Design of multi-wavelength achromatic transmission sphere based on zoom principle** [11552-45]
- 11552 19 **Study on phase stability characteristics of optically controlled phased array radar antenna system** [11552-47]
- 11552 1A **Comparison measurement of absolute power responsivity of silicon photodetector between He-Ne laser and supercontinuum white light source** [11552-48]
- 11552 1B **Methods improve micro multiple configurations** [11552-49]
- 11552 1C **Comparative research on two methods of straight line extraction based on sub-pixel** [11552-50]
- 11552 1D **Numerical analysis and simulation optimization design of coplanar waveguide in electro-optic sampling system** [11552-51]
- 11552 1F **Interferometric testing of cylindrical inner surface** [11552-53]
- 11552 1G **Research of relative spectral responsivity calibration of InGaAs photodetector based on supercontinuum light source** [11552-54]
- 11552 1H **A novel absolute phase retrieval method requiring only three projected patterns** [11552-55]
- 11552 1I **Active stereo vision system with a mechanical projector** [11552-56]
- 11552 1J **Optimization of a frequency comb-based calibration of a tunable laser** [11552-57]
- 11552 1M **Laser scattering characteristics of common roads** [11552-60]
- 11552 1N **Feature identification of non-stochastic surfaces with non-subsampled contourlet transform** [11552-61]
- 11552 1P **A new phase unwrapping method based on inner-fringe coding** [11552-63]

- 11552 1R **Evaluation of ranges of thermal imagers on the basis of static parameters** [11552-65]
- 11552 1U **Recent advances in measurement of radiometric aperture area using optical method at NIM**
[11552-68]
- 11552 1V **A new spectral responsivity calibration comparison of InGaAs photodiode based on cryogenic radiometer fundamentals at the National Institute of Metrology of China** [11552-69]
- 11552 1X **Self-calibration method using the orientation- and scale-covariant features in planar scene**
[11552-71]
- 11552 1Y **Measurement of interactive matrix and flat-surface calibration of OKO 109-channel deformable mirror using ZYGO-GPI interferometer** [11552-72]
- 11552 1Z **Demodulation of fringe patterns corrupted by non uniform intensity variations in dynamics studies** [11552-73]