PROCEEDINGS OF SPIE

Applied Optical Metrology II

Erik Novak James D. Trolinger Editors

8–9 August 2017 San Diego, California, United States

Sponsored and Published by SPIE

Volume 10373

Proceedings of SPIE 0277-786X, V. 10373

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 Applied Optical Metrology II, edited by Erik Novak, James D. Trolinger, Proceedings of SPIE Vol. 10373 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

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

ISBN: 9781510612037 ISBN: 9781510612044 (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 Vm7 i ffUb 5ggc WUHY gz & Wzi bXYf WbgY Zfca GD-9.

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

- vii Authors
- ix Conference Committee
- xi Introduction

SESSION 1 3D SHAPE MEASUREMENT

- 10373 02 Usefulness of orthogonal basis sets for predicting optical performance of wavefronts with mid-spatial frequency error (Invited Paper) [10373-1]
- 10373 04 Fusion of light-field and photogrammetric surface form data [10373-4]
- 10373 05 Expansion of measurement area of three-dimensional deformation measurement speckle interferometry with same sensitivities in three directions under consideration of measurement sensitivity [10373-5]
- 10373 06 Form and position measurement of sheet metal parts by boundary outlines extracting strategy [10373-6]

SESSION 2 POLARIZATION MEASUREMENT AND TECHNIQUES

- 10373 07 Application of polarization in high speed, high contrast inspection [10373-7]
- 10373 09 Measurement of polarization state of light using in-plane spin splitting [10373-9]
- 10373 0A The photonic spin Hall effect sensor [10373-10]

SESSION 3 FINE SCALE FEATURE METROLOGY

- 10373 0B Vibration-immune compact optical metrology to enable production-line quantification of fine scale features [10373-11]
- 10373 0C Experimental investigation of natural convection in a rectangular cavity with two protruded half cylinders using a Mach-Zehnder interferometer [10373-13]
- 10373 0D Authentication Sensing System Using Resonance Evaluation Spectroscopy (ASSURES) [10373-14]
- 10373 OE Optical mapping of surface roughness by implementation of a spatial light modulator [10373-15]

10373 0G Dimensional metrology of micro structure based on modulation depth in scanning broadband light interferometry [10373-38]

SESSION 4 OPTICAL TESTING

10373 OH	Phase measuring deflectometry for determining 5 DOF misalignment of segmented mirrors [10373-16]
10373 OI	Deflectometry for measuring mount-induced mirror surface deformations [10373-17]
10373 OJ	General testing method for refractive surfaces based on reverse Hartmann test [10373-18]
10373 OK	Geometrical error calibration in reflective surface testing based on reverse Hartmann test [10373-20]
10373 OL	Study of annular sub-aperture stitching interferometry for aspheric surfaces [10373-21]
SESSION 5	SPECTROSCOPIC TECHNIQUES AND METROLOGY
10373 OM	Development of an oxygen saturation measuring system by using near-infrared spectroscopy [10373-22]
10373 ON	Metrology of semiconductor structures using novel Fabry Perot fringe stretching system [10373-23]
10373 0O	Rapid, automated, quality control of diffraction grating efficiency [10373-24]
10373 OP	Spatially and temporally resolved diagnostics of dense sprays using gated, femtosecond, digital holography [10373-25]
SESSION 6	FRINGE PROJECTION AND STRUCTURED LIGHT
10373 0Q	Multimodal and synthetic aperture approach to full-field 3D shape and displacement measurements (Invited Paper) [10373-39]
10373 OR	Focusing schlieren systems using digitally projected grids [10373-26]
10373 OS	Application of instrument transfer function to a fringe projection system for measuring rough surfaces [10373-27]
10373 OT	A three-dimensional scanning apparatus based on structured illumination method and its application in dental scanning [10373-28]

10373 0U A calibration method immune to the projector errors in fringe projection profilometry [10373-29]

	POSTER SESSION
10373 OV	Collimator focus check with interferometer [10373-30]
10373 OW	Characterizing the surface fluctuation of an epitaxial wafer by using a Shack-Hartmann wave-front sensor [10373-31]
10373 OZ	Advanced polarization sensitive analysis in optical coherence tomography [10373-34]
10373 10	Optical stabilization for time transfer infrastructure [10373-35]
10373 12	Robust phase unwrapping algorithm for 3D profile measurement applications [10373-37]
10373 13	Measurement of vibration using phase only correlation technique [10373-40]