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Angela D. Davies

Editors

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Contents

vii	<i>Authors</i>
ix	<i>Conference Committee</i>
xiii	<i>Introduction</i>

SESSION 1 SPECKLE

10749 02	Three-dimensional shape measurement beyond the diffraction limit of lens using speckle interferometry [10749-1]
10749 03	Speckle contrast calculation based on pixels correlation: spatial analysis [10749-2]
10749 04	Contrast temporal analysis using correlation between frames [10749-4]

SESSION 2 SHAPE AND THICKNESS MEASUREMENT

10749 05	The dimensional measurement of micro objects using the linear scanning confocal surface shape measurement system [10749-5]
10749 06	Features of surface contouring by digital holographic interferometry with tilt of the object illumination [10749-6]
10749 07	One part-per-million wafer thickness measurement repeatability using fast frequency space Moire effect tool [10749-7]
10749 08	Influence of measured surface materials on the accuracy of 3D measurement using fringe projection [10749-8]
10749 09	Single-shot RGB polarising interferometer [10749-54]

SESSION 3 VIBRATION ANALYSIS

10749 0A	Laser-Doppler vibrometry with variable GHz heterodyne carrier via frequency-offset lock [10749-10]
10749 0B	Vibration amplitude determination through besselogram modulation analysis [10749-11]
10749 0C	A non-destructive evaluation system for additive manufacturing based on acoustic signature analysis with laser Doppler vibrometry [10749-12]

SESSION 4 VIKRAM AWARD LECTURE I

10749 OD **From the speckle interferometer to digital holography (Invited Paper)** [10749-13]

SESSION 5 SHAPE MEASUREMENT AND DEFLECTOMETRY: JOINT SESSION WITH CONFERENCES 10742 AND 10749

10749 OE **High-resolution 3D shape deformation, displacement and strain measurement for robotic flapping wings (Invited Paper)** [10749-14]

10749 OF **Grey-level coding for structured-light illumination systems** [10749-15]

10749 OG **Characterization of the interpolation bias in the analysis of deflectometry measurement data** [10749-16]

SESSION 6 BIO-RELATED TECHNIQUES

10749 OH **Moiré effect-based interference microscopy for biospecimen characterization (Invited Paper)** [10749-17]

10749 OI **Multi-spectral digital holography with high-speed wavelength switching and high-speed camera** [10749-18]

10749 OJ **Multi-beam spatially multiplexed interference microscopy for phase objects examination** [10749-19]

10749 OK **A new morphological cell parameter based on optical phase for the evaluation of cell populations** [10749-20]

10749 OL **Unlabeled flow cellular deformation measurement based on digital holographic microscopy** [10749-21]

SESSION 7 ON THE FRINGE

10749 OM **Dual sensing-light-sheet OCT for microfluidic PTV (Invited Paper)** [10749-22]

10749 ON **Amplitude checker grating-based multichannel lateral shear interferometry for extended aberration sensing** [10749-23]

10749 OO **Multi-path interferometer structures with cleaved silica microspheres (Will be published on 24 August, 2018)** [10749-24]

SESSION 8 **VIKRAM AWARD LECTURE II**

10749 OP **A wonderful life of holography, interferometry, and optical testing (Invited Paper)** [10749-25]

SESSION 9 **CHARACTERIZATION**

10749 OQ **Surface-height measurement noise in interference microscopy (Invited Paper)** [10749-26]

10749 OR **Characterization and operation optimization of large aperture optical interferometers using binary pseudorandom array test standards** [10749-27]

10749 OS **Specification and measurement of uncertainty in phase shifting Fizeau interferometry** [10749-28]

10749 OT **Model based error separation of power spectral density artefacts in wavefront measurement** [10749-29]

SESSION 10 **TECHNIQUES I**

10749 OU **Towards instantaneous spectrally controlled interferometry (Invited Paper)** [10749-30]

10749 OV **Arbitrary phase shifting in diffraction common path interferometry** [10749-31]

10749 OW **Minimizing the Abbe-offset in interferometric radius metrology** [10749-32]

10749 OX **Dynamic interferometric measurements employing a pixelated polarization sensor and FFT spatial-temporal filtering techniques** [10749-33]

SESSION 11 **LOW COHERENCE**

10749 OY **Sampling the coherence function: a novel method for shape measurement** [10749-34]

10749 OZ **Synchronized real-space and frequency-domain low-coherence interferometry for wafer thickness and metrology applications** [10749-35]

10749 10 **Short coherence dynamic Fizeau interferometer with internal path matching for radius of curvature measurement** [10749-36]

10749 11 **Inspection of hidden MEMS by an infrared low-coherence interferometric microscope** [10749-38]

10749 12 **Low-coherence interferometry in laser processing: a new sensor approach heading for industrial applications** [10749-52]

SESSION 12 TECHNIQUES II

- 10749 13 **Multi-wavelength phase unwrapping: a versatile tool for extending the measurement range, breaking the Nyquist limit, and encrypting optical communications** [10749-39]
- 10749 14 **Robust phase-shifting algorithms designed for high-dynamic range in fringe-projection profilometry** [10749-40]
- 10749 15 **Synthetic aperture phase-shifting interferometry for high numerical-aperture spherical surface measurement** [10749-41]
- 10749 16 **Further improvements of digital interferometer** [10749-42]

POSTER SESSION

- 10749 17 **Object scanning scheme in wide-field low-coherence interferometry** [10749-37]
- 10749 18 **Research on marine plankton imaging based on digital holographic technology** [10749-45]
- 10749 19 **Analysis of the local defects of a concave spherical surface using three measurement techniques** [10749-46]
- 10749 1A **Stokes and Jones matrix polarimetry based on geometric phase measurements** [10749-47]
- 10749 1C **Interferometric measurements of phase objects by using a simultaneous polarizing phase shifting Mach-Zehnder interferometer** [10749-49]
- 10749 1D **High-accuracy three-dimensional tomographic observation of cell clusters** [10749-50]
- 10749 1E **Improvement of topography measurement using denoising approach in Fourier digital holographic microscopy** [10749-53]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Pan, Feng, 0L, 1D	Hayasaki, Yoshio, 0I
Al-Bashir, S., 09	Hibino, Kenichi, 15
André, Stephan, 12	Hinago, Tatsuya, 05
Arai, Y., 02	Hu, Yingtian, 18
Austria-González, León Felipe, 19	Huang, Yu-Hsuan, 0I
Babin, Sergey, 0R	Hung, Wei-Chun, 07, 0Z
Bartelt, Hartmut, 0O	Hyra, Andreas, 0Y
Beck, Tobias, 12	Ishihara, Mitsuhiro, 05
Becker, Martin, 0O	Islas-Islas, Juan-Manuel, 1C
Belashov, Andrei V., 0Y	Jiang, Ming, 16
Bergmann, Ralf B., 0Y	Jiang, X., 09
Bergner, Brent C., 0S	Józwik, Michał, 1E
Cabrini, Stefano, 0R	Juarez Ramirez, J. C., 03, 04
Canales-Pacheco, Benito, 19, 1C	Karami, Fatemeh, 0O
Cao, Runyu, 0L	Kogel-Hollacher, Markus, 12
Charrett, T. O. H., 0M	Kowarsch, Robert, 0A
Chiu, R., 03, 04	Kozacki, Tomasz, 1E
Cornejo-Rodríguez, A., 19	Krauter, Johann, 11
Coyotl-Ocelotl, B., 03, 04	Kumagai, Toshiki, 15
Cywińska, Maria, 0H	Lacey, Ian, 0R
Darias G., José R, 0K	Lal, Amit, 0C
Davies, Angela, 0G	Latifi, Hamid, 0O
de Groot, Peter, 0Q	Li, Beiwen, 0E
Dellith, Jan, 0O	Li, Xueyuan, 16
De-Luna-Pamanes, A., 1A	Li, Ying, 1D
Dimas, Dave, 0C	Liebl, Johannes, 0T
Dioumaev, Andrei K., 0C	Liu, Chao, 18
DiSciaccia, Jack, 0Q	Lopez-Mago, D., 1A
Escobar-Acevedo, Marco A., 1C	Lotz, Markus, 0W
Falaggis, Konstantinos, 0F, 13	Ma, Xichao, 1D
Falldorf, Claas, 0Y	Mai, Torsten, 0W
Fedin, Alexander V., 06	Márquez, Ana H., 0K
Ford, H. D., 0M	Melendez-Montoya, I., 1A
Frazão, Orlando, 0O	Mico, Vicente, 0H, 0J
Frey, Eric, 10	Mikuła, Marta, 1E
Fuchs, Ulrike, 0W	Miura, Kenjiro T., 17
Fütterer, Gerald, 0T	Montes-Perez, Areli, 1C
Gao, F., 09	Monzalvo-Hernandez, Angel, 1C
Garcia-Lechuga, Luis, 1C	Morency, Raphael, 07, 0Z
Garnica, Guillermo, 14	Muhamedsalih, H., 09
Gomes, André D., 0O	Munehika, Keiko, 0R
Gonzalez-Hernandez, D. L., 1A	Nagaike, Yasunari, 15
González-Lapea, Jesús, 0K	Noriega-Loredo, Raymundo Sergio, 19
Griesmann, Ulf, 0R	Noris-Suárez, Karem, 0K
Haberl, Alexander, 0T	North Morris, Michael, 10
HadavandMirzaee, Fatemeh, 0V	Olczak, Artur, 0U
Hallam, J. M., 0M	Ortega Mendoza, Jose Gabriel, 1C
Han, Sen, 16	Osten, Wolfgang, 0T, 11
Harsch, Antonia, 0T	Otani, Yukitoshi, 05, 0X

Padilla, Moises, 14
 Patorski, Krzysztof, 0H, 0J, 0N
 Petrov, Nikolay V., 06
 Picazo-Bueno, Jose Angel, 0H, 0J
 Pina-Hernandez, Carlos, 0R
 Porras-Aguilar, Rosario, 0F, 0V, 13
 Pouya Fard, Ali, 0G
 Pruß, Christof, 0T
 Ramirez-Andrade, Ana Hiza, 13
 Ramirez-San-Juan, J. C., 03, 04
 Ramos-Garcia, R., 03, 04
 Rascher, Rolf, 0T
 Rembe, Christian, 0A
 Resendiz-Lopez, German, 1C
 Rigas, E., 0M
 Rothhardt, Manfred, 0O
 Salisbury, Chase, 0U
 Sausedo Solorio, Jose Manuel, 1C
 Serrano-García, David I., 0X, 1C
 Servin, Manuel, 14
 Shen, Joseph, 08
 Shevkunov, Igor A., 06
 Shi, Zheng, 18
 Silveira, Beatriz, 0O
 Simic, Aleksander, 0Y
 Skobnikov, Vladislav A., 06
 Służewski, Łukasz, 0N
 Spezzia-Mazzocco, Teresita, 03, 04
 Stetson, Karl A., 0D
 Styk, Adam, 0B
 Suleski, Thomas, 0V
 Sun, Hao, 16
 Tang, Ming, 18
 Tatam, R. P., 0M
 Toto-Arellano, Noel Ivan, 19, 1C
 Towers, Catherine, 13
 Towers, David, 13
 Trolinger, James, 0C
 Trusiak, Maciej, 0H, 0J, 0N
 Usuki, S., 17
 Walecki, Wojtek J., 07, 0Z
 Wang, Qixiang, 0L
 Wang, Quandou, 0R
 Wang, Quanzhao, 16
 Wang, Xiaoping, 18
 Wiegmann, Axel, 0W
 Williams, Desmond, 0V
 Winnik, Julianna, 1E
 Wyant, James C., 0P
 Xiao, Wen, 0L, 1D
 Yashchuk, Valeriy V., 0R
 Yi, Xiaosu, 0L, 1D
 Zdańkowski, Piotr, 0H, 0J, 1E
 Zhang, Bo, 16
 Zhang, Linghua, 16
 Zhuang, Jincheng, 16
 Zibaii, Mohammad I., 0O

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- 6 Bio-related Techniques
Rosario Porras-Aguilar, The University of North Carolina at Charlotte (United States)

- 7 On the Fringe
Adam R. Styk, Warsaw University of Technology (Poland)
- 8 Vikram Award Lecture II
Katherine Creath, Optineering (United States) and The University of Arizona (United States)
- 9 Characterization
Dae Wook Kim, College of Optical Sciences, The University of Arizona (United States)
- 10 Techniques I
Peter J. de Groot, Zygo Corporation (United States)
- 11 Low Coherence
Joanna Schmit, 4D Technology Corporation (United States)
- 12 Techniques II
Brent C. Bergner, Mahr-ESDI (United States) and Process Measurement Resources (United States)

Introduction

This is the nineteenth installment of the Interferometry conference – it has not always taken place in the current bi-annual format, so its beginnings reach back to the 1980s. For those of you who are old enough to remember, take a moment to re-play the reel of progress since; for those who are not, take a look at a yellow book with a three-digit number or download a scanned typewriter manuscript, marvel at the clumsy ways things were done then, and realize that the reason we are looking so much smarter today is because we are. All the mistakes we make (and share), all this apparent erring and bumbling leads to knowledge of how we might have begun in the first place — just one case and success story in point: the Laser Interferometer Gravitational-Wave Observatory founders having won the 2017 Nobel Prize in Physics. As such, we understand this book to be another chapter in the endless chronicle of trial, error, and improvement.

This is our second conference where we have combined “Techniques and Analysis” and “Applications”. The late August date of the meeting this year has conflicted with the start of school for many of our colleagues. We look forward to having them join us next time. As we do each time we meet, we are looking forward to the discussion with you about the future and format of the conference. We strive to include as many new topics and new presenters from around the world as possible with each conference.

With this conference we have an on-site proceedings – meaning the published papers are available at the meeting to the attendees. We have found this adds substantial depth to our interactions and conversations with one another. The hard part about this is reminding and pestering authors to get their papers in on time. We review every paper and ask authors to revise their papers according to the reviewers’ comments. The Chairs would like to encourage potential authors to start such foreseeable processes early – being focused on the scientific results, it is easy to forget about the more mundane things around attending a conference. Also, from experience, it is a good idea to have at least part of the results already “in the bag” – there is not one among us who has never experienced the last-minute rush that comes with trying to meet a deadline that involves the rest of the experimental program besides the writing process.

Having said that, we do applaud our authors, and are very happy with the quality of the material we did receive. As usual, it has gone through a peer-review process with our 37 committee members from 17 countries to ensure we all get a conference volume that will be useful as a reference for many years. The featured authors, from 14 countries, have brought inspiring papers to this forum, which we are very pleased to present in this book. It contains 48 papers presented at the SPIE’s 63rd Annual Meeting in San Diego on August 18 – 23, 2018. Over 40 of these papers were presented orally.

When thinking of interferometry, the first thing coming to mind is of course the phase of wavefronts, as used so beautifully in non-destructive testing and holography. One feature of this conference is continuation of the Chandra S. Vikram Award Lecture. This year we are featuring the current 2018 Chandra S. Vikram Award winner Karl A. Stetson of Karl

Stetson Assoc., LLC presenting his work "From the speckle interferometer to digital holography," as well as the 2010 Chandra S. Vikram Award winner James C. Wyant giving a retrospective of his career titled "A wonderful life of holography, interferometry, and optical testing." We're highlighting these presentations with ample time for questions, and we're sure you'll enjoy presentations and papers of both these giants in our field. We plan to continue highlighting winners of this award at future conferences.

While LIGO was surely the cover story of the last 2 years, we have a number of other contributions on pushing the boundaries of metrology and detection methods, as well as further progress reports on the timeless topic of advanced fringe generation and analysis. Calibration methods are the foundation of quantitative metrology, and this topic is also covered by several authors from different areas of research. A useful complement to interferometry is deflectometry, using geometrical optics for measurements with very high dynamic range, and some practical applications of the technique are featured in this volume.

Further classical topics such as speckle interferometry and digital holography are also represented – just like any other topic, they started as tentative new ideas several decades ago and are now serving as an established base for many initially unusual ideas of today. Finally, we have a section on multiple-beam interferometers, viz., very sensitive grating sensors, whose principles are also well known and whose use continues to spread.

The range of topics presented reflects the versatility and ubiquity of optical metrology – like the photon itself, it pervades our world, and its importance is most easily recognized in its absence.

During our last conference in 2016, we had once more a very lively and fun Fringe Art competition with several rounds of voting, choosing our favorite fringe patterns from those brought along by attendees. The origin of phenomena submitted to the Fringe Art Competition spanned the range from Ronchi gratings and biofilms to more common applications such as defect detection, moiré, vibration and stress patterns, cracks, and crystals.

The image selected as the favorite was submitted by Łukasz Służewski, Krzysztof Patorski, and Maciej Trusiak of Warsaw University of Technology, Institute of Micromechanics and Photonics. This image represents the 2D Fourier spectrum of an interference fringe pattern obtained using a 2D Ronchi grating shearing interferometer. A spatial filter after the

grating passes the lowest 3 x 3 diffraction orders. The test lens was placed backwards to produce spherical aberration that gives rise to the comatic features in the Fourier image. The dark fringes across the comatic spots correspond to 2nd-order spatial derivatives of the spherical aberration, and the weak cross patterns over the zero and 1st-order spectra are due to parasitic interference caused by multiple reflections in the CCD cover glass. In other words, the features in this wonderful picture are not things you really every want to see when you're testing a lens, but here they are as a work of art.

Our 2nd-place winner shows a colorful residual stress pattern in PMMA by Achyut Adhikari of the Center for Optical & Laser Engineering in Singapore. And, finally, our 3rd-place winner shows a bacterial biofilm titled "Beautiful Bug" by Curtis Lamier of the Pacific Northwest Laboratories.

Let us close with a sincere thank-you to SPIE, the program committee, the authors, and everyone attending this nineteenth Interferometry conference. As we have said a number of times, metrology never goes out of style, and a few things deemed too hard or even impossible even two years ago have been demonstrated now, encouraging further demands for the (almost) impossible (again, who of us has not experienced this?!). Besides the incremental broadening of scopes and sharpening of sensitivities, there were also "the usual surprises", i.e. innovative uses opening up new ways of thinking. We are very pleased that SPIE continues to support and provide this forum for us.

Until next time!

**Katherine Creath
Jan Burke
Michael B. North-Morris
Angela D. Davies**