

**SPIE.** OPTICAL  
METROLOGY



INTERNATIONAL  
YEAR OF LIGHT  
2015



# OPTICAL METROLOGY.

TECHNICAL  
PROGRAMME

[WWW.SPIE.ORG/OM](http://WWW.SPIE.ORG/OM)

22-25 June 2015  
Internationales Congress Center  
Munich, Germany

22nd International Congress on Photonics in Europe  
Collocated with LASER 2015 World of PHOTONICS

**WORLD OF PHOTONICS CONGRESS**

[www.photonics-congress.com](http://www.photonics-congress.com)





INTERNATIONAL  
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2015

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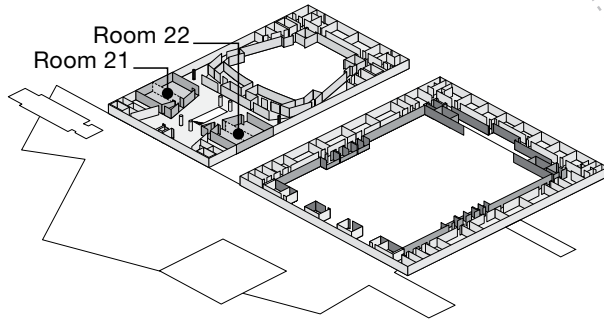


daily coverage of the optics and photonics  
industry and the markets that it serves

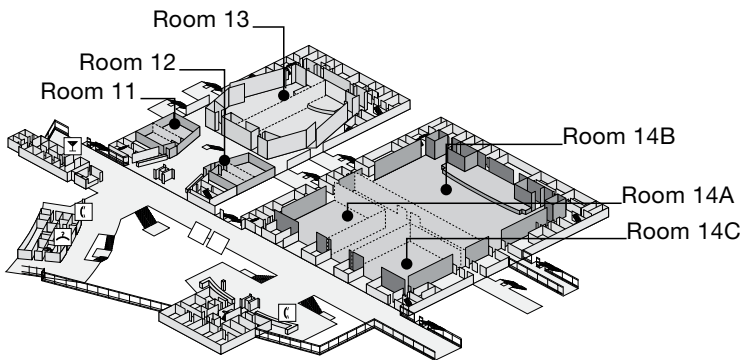
 the business of photonics  
**optics.org**

# FACILITY MAPS

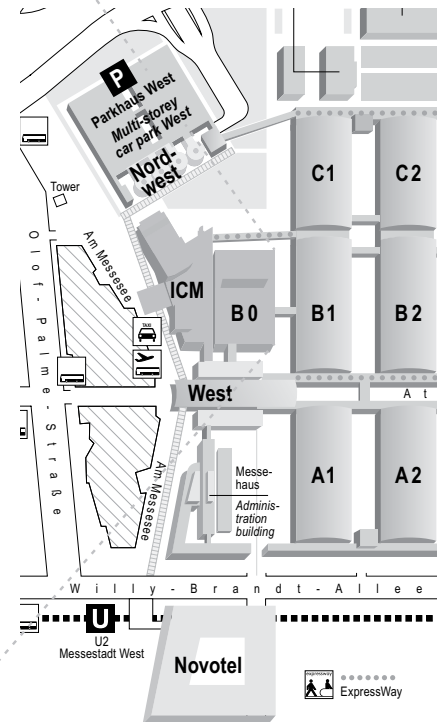
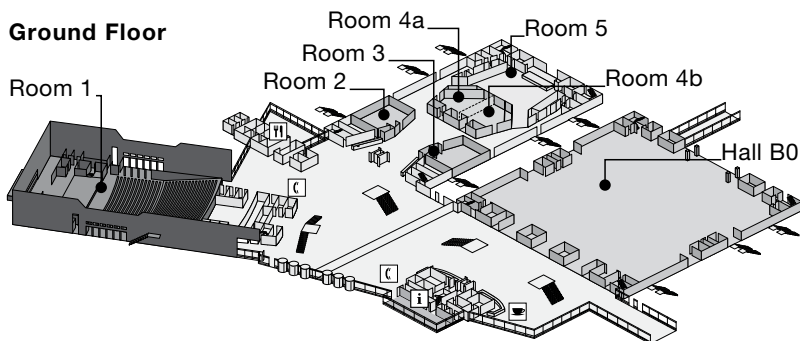
## Second Floor



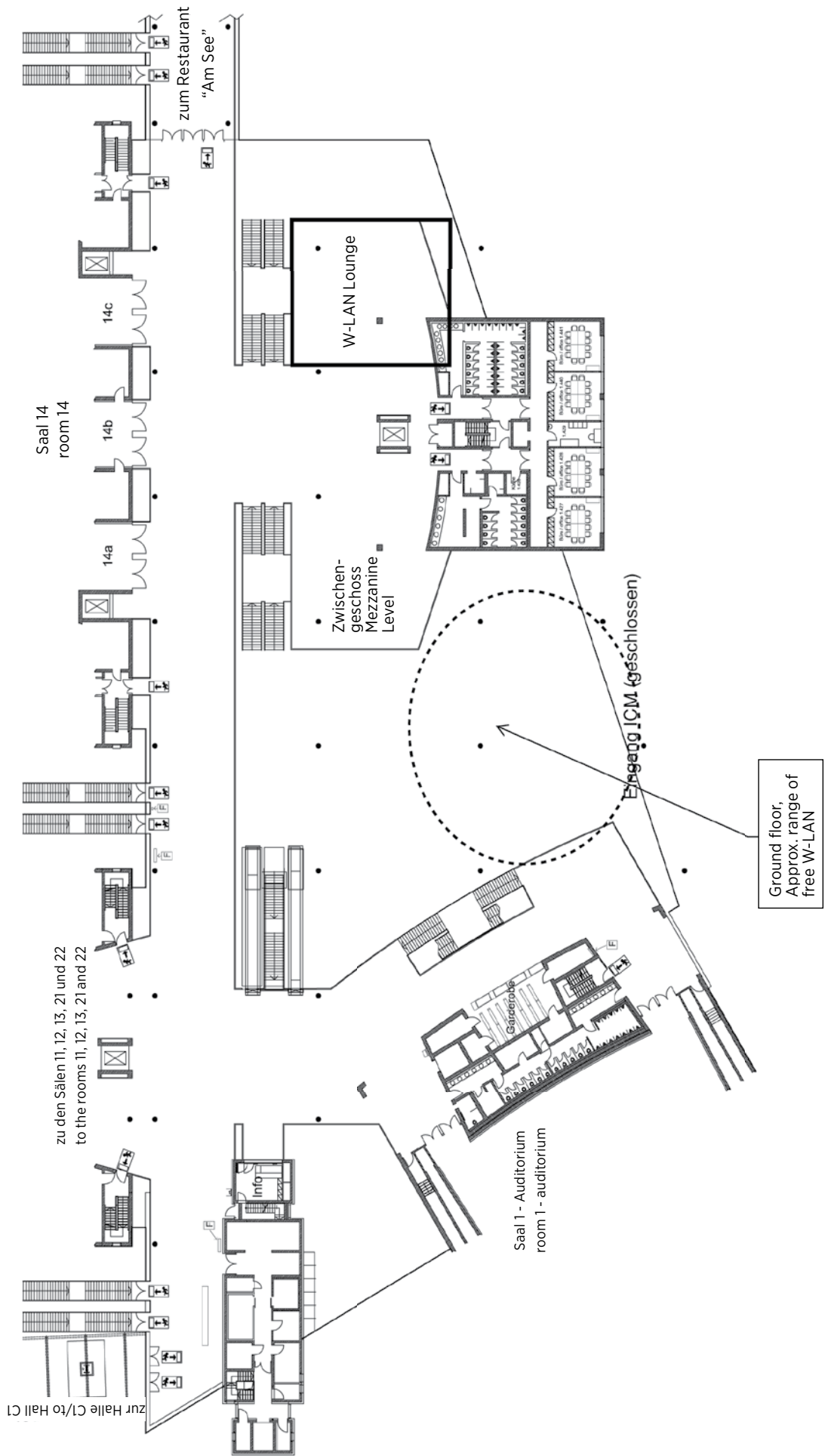
## First Floor



## Ground Floor



# FACILITY MAPS







## Technical Committee

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**Simonetta Grilli**, Istituto Nazionale di Ottica (Italy)

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**Gunther Notni**, Fraunhofer Institute for Applied Optics and Precision Engineering (Germany)

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**Ralph P. Tatam**, Cranfield Univ. (UK)

## Contents.

Facility Maps .....	1-2
Daily Event Schedule .....	5
Plenary session .....	5
Special Events .....	6

## Technical Conferences

**9525 Optical Measurement Systems for Industrial Inspection IX. . . . . 8**

**9526 Modeling Aspects in Optical Metrology V. . . . . 14**

**9527 Optics for Arts, Architecture, and Archaeology V. . . . . 17**

**9528 Videometrics, Range Imaging, and Applications XIII. . . . . 19**

**9529 Optical Methods for Inspection, Characterization, and Imaging of Biomaterials II. . . . . 21**

**9530 Automated Visual Inspection and Machine Vision . . . . . 24**

Index of Authors, Chairs, and Committee Members. . . . . 26-31

General Information. . . . . 32-33

SPIE Event Policies . . . . . 34-35

Proceedings of SPIE. . . . . 36

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SPIE is the international society for optics and photonics, an educational not-for-profit organization founded in 1955 to advance light-based technologies. The Society serves nearly 264,000 constituents from 166 countries, offering conferences, continuing education, books, journals, and a digital library in support of interdisciplinary information exchange, professional networking, and patent precedent. SPIE provided more than \$4 million in support of education and outreach programs in 2014. [www.spie.org](http://www.spie.org)

# 2015 OPTICAL METROLOGY.

**22-25 June 2015**

Internationales Congress Center,  
Munich, Germany

## 2015 Symposium Chairs:



**Wolfgang Osten**  
Univ. Stuttgart (Germany)



**Gunther Notni**  
Fraunhofer Institute for  
Applied Optics and  
Precision Engineering  
(Germany)



**Andrew J. Moore**  
Heriot-Watt Univ. (United  
Kingdom)

*SPIE would like to express its deepest appreciation to the symposium chairs, conference chairs, programme committees, session chairs, and authors who have so generously given their time and advice to make this symposium possible. The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members. This programme is based on commitments received up to the time of publication and is subject to change without notice.*

## Welcome to Munich!

Take this opportunity to share your research at SPIE Optical Metrology 2015. Come to Munich to meet with users and researchers to discuss the latest inventions and applications in the field of optical metrology. The symposium will highlight new optical principles and systems for metrology, videometrics, and machine vision with applications in industrial design, production engineering, process monitoring, maintenance support, biotechnology, vehicle navigation, multimedia technology, architecture, archaeology, and arts. Special emphasis is directed to model-based, remote and active approaches, sensor fusion, robot guidance, image sequence processing and scene modelling, and biomaterials characterization, as well as to the preservation of our shared cultural heritage.

We invite engineers, scientists, researchers, trustees, and managers to attend this year's meeting.

Co-located with Laser 2015 in Munich, Germany, this symposium will address the role of optics and lasers in the following areas:

- Optical Measurement Systems for Industrial Inspection
- Modeling Aspects in Optical Metrology
- Optical Methods for Inspection, Characterization and Imaging of Biomaterials
- Videometrics, Range Imaging and Applications
- Automated Visual Inspection and Machine Vision
- Optics for Arts, Architecture, and Archaeology

Take advantage of this unique opportunity to hear about the latest solutions to practical problems in industrial design and production engineering. Learn about recent advances in using optical technologies to preserve our shared cultural heritage. Find out about new approaches that push optical principles of measurement and testing at the macro, micro- and nanoscales to the forefront of metrology. Exchange new ideas, address your shared concerns, and get access to information not yet published in the mentioned topical areas. Share your research with other engineers, scientists, researchers, and managers. Presentations will be permanently archived in the SPIE Digital Library, and made available to others in the international scientific community who seek to learn, make discoveries, and innovate.

We invite you to join your colleagues and share the most recent developments and applications at SPIE Optical Metrology 2015.

Sponsored by:

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# DAILY EVENT SCHEDULE

Monday June 22	Tuesday June 23	Wednesday June 24	Thursday June 25
Conf. 9525: <b>Optical Measurement Systems for Industrial Inspection</b> (Lehmann)			
	Conf. 9526: <b>Modeling Aspects in Optical Metrology</b> (Bodermann)		
Conf. 9528: <b>Videometrics, Range Imaging, and Applications</b> (Remondino, Shortis)	Conf. 9527: <b>O3A: Optics for Arts, Architecture, and Archaeology</b> (Pezzati, Targowski)		
Conf. 9529: <b>Optical Methods for Inspection, Characterization and Imaging of Biomaterials</b> (Ferraro, Grilli, Ritsch-Marte, Stifter)		Conf. 9530: <b>Automated Visual Inspection and Machine Vision</b> (Beyerer, Puente-Leon)	
	POSTER SESSIONS-CONFERENCES 9525, 9526, 9528, 9529, 9530	POSTER SESSION-CONFERENCE 9527	
		PLENARY SESSION <b>Extreme Computational Imaging: Photography, Health-tech and Displays</b> (Raskar)	
		IYL HAPPY HOUR	
		WELCOME RECEPTION	

## PLENARY SESSION

Wednesday, 10:30 to 11:25

Location: **Saal 1**

10:30 to 10:35

### Welcome and Introduction

10:35 to 10:40

### Presentation of the Dennis Gabor Award

to



**Kazuyoshi Itoh**, Osaka University Japan

for his eminent contribution to the development of incoherent holography and nonlinear optical microscopy through his pioneering work on coherence-based multispectral and 3D imaging, and nonlinear optical imaging and manipulations of biological and inorganic industrial materials.

10:40 to 11:25

### Extreme Computational Imaging: Photography, Health-tech and Displays



**Ramesh Raskar**, MIT Media Lab., United States

The Camera Culture Group at the MIT Media Lab aims to create a new class of imaging platforms. This talk will discuss three tracks of research: femto photography, retinal imaging, and 3D displays.

Femto Photography consists of femtosecond laser illumination, picosecond-accurate detectors and mathematical reconstruction techniques allowing researchers to visualize propagation of light. Direct recording of reflected or scattered light at such a frame rate with sufficient brightness is nearly impossible. Using an indirect 'stroboscopic' method that records millions of repeated measurements by careful scanning in time and viewpoints we can rearrange the data to create a 'movie' of a nanosecond long event. Femto photography and a new generation of nano-photography (using ToF cameras) allow powerful inference with computer vision in presence of scattering.

EyeNetra is a mobile phone attachment that allows users to test their own eyesight. The device reveals corrective measures thus bringing vision to billions of people who would not have had access otherwise. Another

project, eyeMITRA, is a mobile retinal imaging solution that brings retinal exams to the realm of routine care, by lowering the cost of the imaging device to a 10th of its current cost and integrating the device with image analysis software and predictive analytics. This provides early detection of Diabetic Retinopathy that can change the arc of growth of the world's largest cause of blindness.

Finally the talk will describe novel lightfield cameras and lightfield displays that require a compressive optical architecture to deal with high bandwidth requirements of 4D signals.

*Biography:* **Ramesh Raskar** is an Associate Professor at MIT Media Lab. Ramesh Raskar joined the Media Lab from Mitsubishi Electric Research Laboratories in 2008 as head of the Lab's Camera Culture research group. His research interests span the fields of computational photography, inverse problems in imaging and human-computer interaction. Recent projects and inventions include transient imaging to look around a corner, a next generation CAT-Scan machine, imperceptible markers for motion capture (Prakash), long distance barcodes (Bokode), touch+hover 3D interaction displays (BiDi screen), low-cost eye care devices (Netra,Catra), new theoretical models to augment light fields (ALF) to represent wave phenomena and algebraic rank constraints for 3D displays(HR3D).

In 2004, Raskar received the TR100 Award from Technology Review, which recognizes top young innovators under the age of 35, and in 2003, the Global Indus Technovator Award, instituted at MIT to recognize the top 20 Indian technology innovators worldwide. In 2009, he was awarded a Sloan Research Fellowship. In 2010, he received the Darpa Young Faculty award. Other awards include Marr Prize honorable mention 2009, LAUNCH Health Innovation Award, presented by NASA, USAID, US State Dept and NIKE, 2010, Vodafone Wireless Innovation Project Award (first place), 2011. He holds over 50 US patents and has received four Mitsubishi Electric Invention Awards. He is currently co-authoring a book on Computational Photography. [Personal webpage <http://raskar.info>] <http://www.media.mit.edu/~raskar>



# SPECIAL EVENTS

## Student Chapter Leadership Workshop

Location: **Fairgrounds, Room B11 "Einstein"**

Saturday 20 June 2015 ..... 9:00 to 17:00

Open to SPIE Student Chapter members



**Jean-luc Doumont**, Principiae

The successful SPIE Student Chapter Leadership Workshop is back in Europe for the fourth time!

During this highly interactive, all-day event facilitated by Dr. Jean-luc Doumont, you will discuss what being a leader is all about (and what it is not about), how to communicate across cultures, and how to go from ideas to achievements for your chapter. Join Student Chapter

officers from around the world for a full day of professional development training and networking.

An engineer (Louvain) and PhD in applied physics (Stanford), Jean-luc is acclaimed worldwide for his no-nonsense approach, his highly applicable, often life-changing recommendations on a wide range of topics, and Trees, maps, and theorems, his book about "effective communication for rational minds." He is a visiting lecturer for SPIE. For more information about Jean-luc, please visit [www.principiae.be](http://www.principiae.be).

All SPIE student chapter members are welcome to attend, but please RSVP to [students@spie.org](mailto:students@spie.org) for confirmation.

## How to Persuade Others

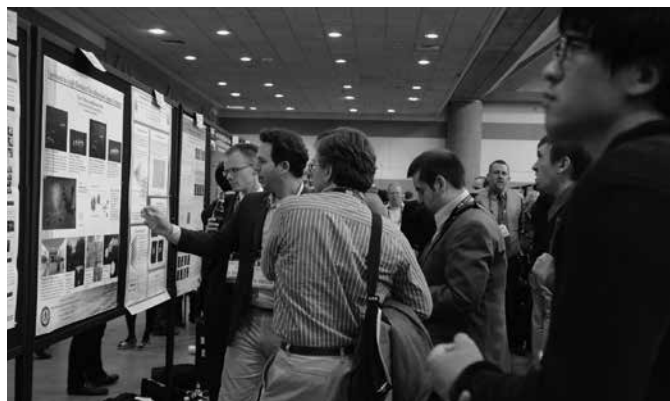
Sunday 21 June 2015 ..... 13:30 to 17:00

Location: **Room 3, Ground Floor Congress Centre**

Open to Students and Early Career Professionals

Being able to persuade others is an essential skill for a successful career: we must convince employers to hire us, persuade our boss to let us start a project, or get our coworkers to help us out for a given job. This workshop shows how to use personal/organizational power, how to deploy tactics, and how to harness social influences so we get other people to accede more easily to our requests. Please email [students@spie.org](mailto:students@spie.org) to register.

*Facilitator:* **Jean-luc Doumont**, Principiae



## Poster Session

Location: **ICM Foyer**

Tuesday 23 June 2015 ..... 17:30 to 19:00  
(Conference 9525, 9526, 9528, 9529, 9530)

Wednesday 24 June ..... 11:30 to 12:30  
(O3A Conference, 9527)

All symposium attendees are invited to attend Tuesday and Wednesday poster sessions provided as an opportunity to enjoy networking while reviewing poster papers.

Poster presenters may post their poster papers starting at 10:00 on Tuesday in the Conference Area and present them during Tuesday and Wednesday Poster Sessions. Any papers left on the boards following 12:00 hrs on Thursday 25 June will be considered unwanted and will be discarded.

SPIE assumes no responsibility for posters left up after the end of the Poster Session. Poster authors should be at their papers on Tuesday and Wednesday to answer questions from attendees. For specific times, please see the individual conference programmes. Attendees are requested to wear their conference registration badges to the poster sessions.

## Students and SPIE Fellows Luncheon

Location: **Fairgrounds, Restaurant Seeblick**

Wednesday 24 June 2015 ..... 12:30 to 14:00

**Students: Advance sign-up required onsite; seating is limited.**

Students and SPIE Fellows are invited to this engaging networking opportunity. This event gives students an opportunity to network with SPIE Fellows who will share their insights into career paths in optics and photonics. Lunch is complimentary, and students must sign up at the SPIE registration desk onsite.

Co-sponsored by



LIGHT2015 is an outreach project to promote the importance of photonics to young people, entrepreneurs and the general public in Europe during the International Year of Light 2015. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 644964.

## Career Choices Panel Discussion

Location: **Exhibition Floor Forum in Hall A2**

Wednesday 24 June 2015 ..... 15:00 to 16:20

What are the critical career choices and decisions that face new graduates in optics and photonics? What are some strategies for navigating the transition from student to professional? This event will feature a career choices discussion and a panel with professionals from a variety of fields in optics and photonics.



**Surviving in Science: what they don't tell you about careers in research!**

**Prof. John Dudley**, FEMTO-ST

Obtaining a PhD is an important and significant achievement in your life, but it is really only the start! A successful career in research requires not only a PhD but also many other skills in multiple areas: from writing and communication, to management and leadership. When starting out, the breadth of this required expertise can seem daunting, but the aim of this presentation will be to try to provide simple and practical advice to help early-career researchers to build and enjoy a long term career in photonics whether in academia or industry.

Co-sponsored by



LIGHT2015 is an outreach project to promote the importance of photonics to young people, entrepreneurs and the general public in Europe during the International Year of Light 2015. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 644964.

## IYL Happy Hour

Location: **ICM Foyer**

Wednesday 24 June 2015 ..... 18:00 to 19:00

Sponsored by

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## Welcome Reception



Location: **Ratskeller am Marienplatz**

(use Entrance on Landschaftstrasse)

Wednesday 24 June 2015  
19:00 to 21:30

This evening event will feature a light meal and beverages. All registered conference attendees are welcome. A guest may accompany a registered attendee for an additional charge (based on space available).





# SPIE WORKSHOPS

## Effective Technical Presentations

### WS897

Course Level: Introductory

CEU: 0.35 · Member Price: US\$175/€155

Non-member Price: US\$225/€200

Free for SPIE Student Members

Sunday 21 June 2015 · 08:30 to 12:30

#### COURSE DETAILS

Oral presentation skills are a key to success for researchers. This course proposes a five-step methodology that will take you from scratch to an effective technical presentation. It also offers tips on how to manage the nervousness associated with speaking in public.

#### LEARNING OUTCOMES

- plan your presentation efficiently
- organize your material into an effective structure
- create slides that get the message across
- deliver your presentation effectively, both verbally and nonverbally
- handle even the most difficult questions

#### INTENDED AUDIENCE

This material is intended for anyone who must prepare and deliver oral presentations. Both novice and experienced speakers can expect to learn much from it.

#### INSTRUCTOR

**Jean-luc Doumont** runs lectures, workshops, and training programs in oral, written, and graphical communication for engineers, scientists, and managers worldwide. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University.

This course is based on his popular lecture on oral presentations at over 15 top-ranked engineering schools (MIT, Stanford U, UC Berkeley, Caltech, Harvard, etc.).

Note: This course is free to SPIE Student Members, but you must register to attend.

## Effective Scientific Papers

### WS908

Course Level: Introductory

CEU: 0.35 · Member Price: US\$175/€155

Non-member Price: US\$225/€200

Free for SPIE Student Members

Monday 22 June 2015 · 08:30 to 12:30

#### COURSE DETAILS

Strong writing skills are a key to success for researchers. This course proposes a methodology that will take you from scratch to an effective scientific or technical document—a question of structure, not style. The approach is applicable across languages and for a wide range of document types beyond scientific papers, too.

#### LEARNING OUTCOMES

- plan your document efficiently
- create an effective abstract, introduction, and conclusion
- organize your material into an accessible structure
- construct paragraphs that get the message across
- write sentences that are easy to read

#### INTENDED AUDIENCE

This material is intended for anyone who must write or edit technical documents in general and scientific papers in particular. Both novice and experienced writers can expect to learn much from it.

#### INSTRUCTOR

**Jean-luc Doumont** runs lectures, workshops, and training programs in oral, written, and graphical communication for engineers, scientists, and managers worldwide. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. This course is based on his lectures and workshops on scientific and technical writing at universities and research centers around the world (MIT, Shell, Johnson & Johnson, etc.).

Note: This course is free to SPIE Student Members, but you must register to attend.

#### MONEY-BACK GUARANTEE

We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like; suggestions for improvement are always welcome.

#### CONTINUING EDUCATION UNITS



SPIE has been approved as an authorized provider of CEUs by IACET, The International Association for Continuing Education and Training (Provider #1002091). In obtaining this approval, SPIE has demonstrated that it complies with the ANSI/IACET Standards which are widely recognized as standards of good practice.

SPIE reserves the right to cancel a course due to insufficient advance registration.

# CONFERENCE 9525

LOCATION: ROOM 14C

Monday–Thursday 22–25 June 2015 • Proceedings of SPIE Vol. 9525

## Optical Measurement Systems for Industrial Inspection IX

Conference Chair: **Peter Lehmann**, Univ. Kassel (Germany)

Conference Co-Chairs: **Wolfgang Osten**, Univ. Stuttgart (Germany); **Armando Albertazzi Gonçalves Jr.**, Univ. Federal de Santa Catarina (Brazil)

Programme Committee: **Oleg V. Angelsky**, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); **Anand Krishna Asundi**, Nanyang Technological Univ. (Singapore); **Ralf B. Bergmann**, Bremer Institut für angewandte Strahltechnik GmbH (Germany); **Harald Bosse**, Physikalisch-Technische Bundesanstalt (Germany); **Chau-Jern Cheng**, National Taiwan Normal Univ. (Taiwan); **Yuri V. Chugui**, Technological Design Institute of Scientific Instrument Engineering (Russian Federation); **Wim M.J. Coene**, ASML Netherlands B.V. (Netherlands); **Jürgen W. Czarske**, Technische Univ. Dresden (Germany); **Peter J. de Groot**, Zygo Corporation (United States); **Pietro Ferraro**, Istituto Nazionale di Ottica (Italy); **Cosme Furlong**, Worcester Polytechnic Institute (United States); **Marc P. Georges**, Univ. de Liège (Belgium); **Christophe Gorecki**, FEMTO-ST (France); **Yoshio Hayasaki**, Utsunomiya Univ. (Japan); **Myung K. Kim**, Univ. of South Florida (United States); **Tomasz Kozacki**, Warsaw Univ. of Technology (Poland); **Richard Kowarschik**, Friedrich-Schiller-Univ. Jena (Germany); **Eberhard Manske**, Technische Univ. Ilmenau (Germany); **Kaoru Minoshima**, The Univ. of Electro-Communications (Japan); **Andrew John Moore**, Heriot-Watt Univ. (United Kingdom); **Gunther Notni**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); **Yukitoshi Otani**, Utsunomiya Univ. (Japan); **YongKeun Park**, KAIST (Korea, Republic of); **Pascal Picart**, Univ. du Maine (France); **Eduard Reithmeier**, Leibniz Univ. Hannover (Germany); **Christian Rembe**, Polytec GmbH (Germany); **Robert Schmitt**, RWTH (Germany); **Cristina Trillo**, Univ. de Vigo (Spain); **Rainer Tutsch**, Technische Univ. Braunschweig (Germany); **Eriko Watanabe**, The Univ. of Electro-Communications (Japan)

### MONDAY 22 JUNE

#### SESSION 1

LOCATION: ROOM 14C ..... MON 11:10 TO 13:00

#### Resolution-enhanced Techniques

Session Chairs: **Peter Lehmann**, Univ. Kassel (Germany); **Wolfgang Osten**, Institut für Technische Optik (Germany)

11:10: **Ultra-precision optical metrology using highly controlled fiber-based frequency combs** (*Invited Paper*), Kaoru Minoshima, Yoshiaki Nakajima, The Univ. of Electro-Communications (Japan) and Japan Science and Technology Agency (JST), ERATO Intelligent Optical Synthesizer (IOS) (Japan); Guanhao Wu, Tsinghua University (China) ..... [9525-1]

11:40: **Deterministic phase retrieval employing spherical illumination**, Juan Martínez-Carranza, Konstantinos Falaggis, Tomasz Kozacki, Warsaw Univ. of Technology (Poland) ..... [9525-2]

12:00: **Digital super-resolution microscopy using example-based algorithm**, Shinji Ishikawa, Yoshio Hayasaki, Utsunomiya Univ. (Japan) ..... [9525-3]

12:20: **3D shape metrology of 80 µm deep vias using TSOM method**, Ravikiran Attota, HyeongGon Kang, Keana Scott, National Institute of Standards and Technology (United States); Carlos Beitia, CEA-LETI (France) ..... [9525-4]

12:40: **3D optical metrology and super-resolution microscopy with structured illumination based on QXGA (2048×1536) resolution**, Henning Molsen, Forth Dimension Displays Ltd. (Germany) ..... [9525-135]

Lunch Break ..... Mon 13:00 to 14:00

#### SESSION 2

LOCATION: ROOM 14C ..... MON 14:00 TO 16:00

#### Interferometric Techniques

Session Chair: **Pasquale Memmolo**, Istituto Italiano di Tecnologia (Italy)

14:00: **Dual spectrally resolved interferometry to improve measurement range**, Yong Bum Seo, Byeong Kwon Kim, Ki-Nam Joo, Chosun Univ. (Korea, Republic of) ..... [9525-6]

14:20: **Full-field and contact-less topography of nanometric thin films based on multiwavelength interferometry**, Pascal Picart, Mokrane Malek, Univ. du Maine (France); Jorge Garcia-Sucerquia, Univ. Nacional de Colombia Sede Medellín (Colombia) and Univ. du Maine (France); Rahma Moalla, Mathieu Edely, Nicolas Delorme, Jean-François Bardeau, Univ. du Maine (France) ..... [9525-7]

14:40: **Novel dispersion tolerant interferometry method for accurate measurements of displacement**, Adrian Bradu, Michael Maria, Univ. of Kent (United Kingdom); Lasse Leick, NKT Photonics A/S (Denmark); Adrian G. Podoleanu, Univ. of Kent (United Kingdom) ..... [9525-8]

15:00: **Phase sensitive computer tomographic measurement using a pixelated phase mask interferometry technique**, David I. Serrano-García, Yukitoshi Otani, Utsunomiya Univ. (Japan) ..... [9525-9]

15:20: **Spatial-frequency analysis algorithm for in-situ measurement of wavefront**, Qian Liu, Yang Wang, Fang Ji, Jianguo He, China Academy of Engineering Physics (China) ..... [9525-10]

15:40: **Nonlinear interferometry and application for black background tomography**, Kamel Mallat, Alain Cornet, Univ. Catholique de Louvain (Belgium); José Luis Fernández, Univ. de Vigo (Spain) ..... [9525-11]

Coffee Break ..... Mon 16:00 to 16:30

#### SESSION 3

LOCATION: ROOM 14C ..... MON 16:30 TO 17:50

#### OCT and Fiber Sensors

Session Chair: **Peter Lehmann**, Univ. Kassel (Germany)

16:30: **Evaluation of polymer matrix homogeneity using functional optical coherence tomography techniques**, Marcin R. Strakowski, Michal Trojanowski, Paulina Strakowska, Maciej Kraszewski, Gdansk Univ. of Technology (Poland) ..... [9525-12]

16:50: **The influence of speckle size in OCT for industrial applications**, Guy Lamouche, Bruno Gauthier, Marc L. Dufour, National Research Council Canada (Canada) ..... [9525-13]

17:10: **Robust fiber optic flexure sensor exploiting mode coupling in few-mode fiber**, Bryan Nelsen, Florian Rudek, Westsächsische Hochschule Zwickau (Germany); Christopher Taudt, Westsächsische Hochschule Zwickau (Germany) and Technische Univ. Dresden (Germany); Tobias Baselt, Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) ..... [9525-14]

17:30: **Distributed fiber optic sensor employing phase generate carrier for disturbance detection and location**, Haiyan Xu, Hohai Univ. (China); Hongyan Wu, Fudan Univ. (China); Xuewu Zhang, Hohai Univ. (China); Zhuo Zhang, Min Li, Hohai Univ. (China) ..... [9525-16]

### TUESDAY 23 JUNE

#### SESSION 4

LOCATION: ROOM 14C ..... TUE 8:10 TO 10:00

#### Digital Holography

Session Chair: **Pascal Picart**, Univ. du Maine (France)

8:10: **Resolution enhancement in phase imaging by using modulated illumination** (*Invited Paper*), Peng Gao, Karlsruhe Institute of Technology (Germany) and Univ. Stuttgart (Germany) ..... [9525-169]

8:40: **Sparsity promoting automatic focusing in digital holography**, Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Melania Paturzo, Istituto di Cibernetica Eduardo Caianiello (Italy); Bahram Javidi, Univ. of Connecticut (United States); Paolo A. Netti, Istituto Italiano di Tecnologia (Italy); Pietro Ferraro, Istituto di Cibernetica Eduardo Caianiello (Italy) ..... [9525-18]

9:00: **Holographic position measurements of an optically trapped nanoparticle**, Kazufumi Goto, Takumi Yanagawa, Ryosuke Abe, Yoshio Hayasaki, Utsunomiya Univ. (Japan) ..... [9525-19]

9:20: **Color holograms synthesis framework for three-dimensional scene reconstruction**, Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Marco Leo, Cosimo Distante, Istituto Nazionale di Ottica (Italy); Melania Paturzo, Pietro Ferraro, Istituto di Cibernetica Eduardo Caianiello (Italy) ..... [9525-20]

9:40: **Off-axis illumination in object-rotation diffraction tomography for enhanced alignment and resolution**, Julianna Kostencka, Tomasz Kozacki, Warsaw Univ. of Technology (Poland) ..... [9525-21]

Coffee Break ..... Tue 10:00 to 10:30

### SESSION 5

LOCATION: ROOM 14C ..... TUE 10:30 TO 12:30

## White-Light Interferometry

Session Chair: **Peng Gao**,

Karlsruhe Institute of Technology (Germany), Univ. Stuttgart (Germany)

10:30: **A new class of wide-field objectives for 3D interference microscopy**, Peter J. de Groot, James F. Biegen, Zygo Corporation (United States) . [9525-22]

10:50: **Interferometric measuring system for cone inspection on shop-floor level**, Till Grübler, Pawel J. Drabarek, Robert Bosch GmbH (Germany) . [9525-23]

11:10: **Cross-linking characterization of polymers based on their optical dispersion utilizing a white-light interferometer**, Christopher Taudt, Tobias Baselt, Westsächsische Hochschule Zwickau (Germany); Gernot Oreski, Polymer Competence Ctr. Leoben GmbH (Austria); Christina Hirschl, Carinthian Tech Research AG (Austria); Edmund Koch, Technische Univ. Dresden (Germany); Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) ..... [9525-24]

11:30: **Robust vertical scanning white-light interferometry in close-to-machine applications**, Stanislav Tereschenko, Peter Lehmann, Pascal Gollor, Peter Kuehnhold, Univ. Kassel (Germany) ..... [9525-25]

11:50: **Development of a compact low coherence interferometer based on GPGPU for fast microscopic surface measurement on turbine blades**, Yinan Li, Markus Kästner, Eduard Reithmeier, Leibniz Univ. Hannover (Germany) ..... [9525-26]

12:10: **Optical coherence tomography for ceramic tableware inspection**, Maciej Kraszewski, Michal Trojanowski, Marcin R. Strakowski, Gdansk Univ. of Technology (Poland) ..... [9525-152]

Lunch Break ..... Tue 12:30 to 13:40

### SESSION 6

LOCATION: ROOM 14C ..... TUE 13:40 TO 15:30

## Speckle and Shearing Interferometry

Session Chair: **Jörg Seewig**,

Technische Univ. Kaiserslautern (Germany)

13:40: **Robust speckle metrology for stress measurements outside the lab** (*Invited Paper*), Matias R. Viotti, Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil) ..... [9525-28]

14:10: **Reduction of phase singularities in speckle-shearing interferometry by incoherent averaging of speckle patterns**, Klaus Mantel, Max-Planck-Institut für die Physik des Lichts (Germany); Vanusch Nercissian, Norbert Lindlein, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) ..... [9525-29]

14:30: **Bending stress determination in pipes using a radial in-plane digital speckle pattern interferometer combined with instrumented indentation**, Filipe Fontana, Matias R. Viotti, Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil) ..... [9525-30]

14:50: **Influence of error sources in speckle interferometry using only two speckle patterns**, Yasuhiko Arai, Kansai Univ. (Japan); Shunsuke Yokozeki, Jyokou Applied Optics Lab. (Japan) ..... [9525-31]

15:10: **A calibration method of self-referencing interferometry based on maximum likelihood estimation**, Chen Zhang, Dahai Li, Mengyang Li, Kewei E, Guangrao Guo, Sichuan Univ. (China) ..... [9525-32]

Coffee Break ..... Tue 15:30 to 16:00

### SESSION 7

LOCATION: ROOM 14C ..... TUE 16:00 TO 17:20

## Confocal and WLI Techniques

Session Chair: **Peter J. de Groot**, Zygo Corporation (United States)

16:00: **Multiplex acquisition approach for high speed 3D measurements with a chromatic confocal microscope**, Mirosław Taphanel, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Ralf Zink, Robert Bosch GmbH (Germany); Thomas Längle, Fraunhofer IOSB (Germany) and Fraunhofer IOSB (Germany); Jürgen Beyerer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) ..... [9525-33]

16:20: **Multi-scale roughness measurement of cementitious materials using different optical profilers and window resizing analysis**, Paul C. Montgomery, Fabien Salzenstein, Gianto Gianto, Univ. de Strasbourg (France); Komla Apedo, ICube (France); Nicolas Serres, Institut National des Sciences Appliquées de Strasbourg (France); Christophe Fond, Univ. de Strasbourg (France); Françoise Feugeas, Institut National des Sciences Appliquées de Strasbourg (France) ..... [9525-34]

16:40: **Calibration of z-axis linearity for arbitrary optical topography measuring instruments**, Matthias Eifler, Jörg Seewig, Julian Hering, Georg von Freyermann, Technische Univ. Kaiserslautern (Germany) ..... [9525-163]

17:00: **Surface topography measurement based on color images processing in white light interferometry**, Tong Guo, Yue Gu, Jinping Chen, Xing Fu, Xiaotang Hu, Tianjin Univ. (China) ..... [9525-36]

### POSTERS—TUESDAY

LOCATION: ICM FOYER ..... TUE 18:00 TO 19:00

Conference attendees are invited to attend the Optical Metrology Poster Session on Tuesday afternoon. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 10:00 hrs on Tuesday through 12:00 hrs on Thursday.

Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**Small angle X-ray scatterometry for overlay measurement**, Deh-Ming Shyu, Industrial Technology Research Institute (Taiwan); Joseph Kline, Daniel F. Sunday, Wen-li Wu, National Institute of Standards and Technology (United States) ..... [9525-5]

**Fibre optic pressure sensor using a microstructured POF**, Oskar Arrizabalaga, Gaizka Durana, Univ. del País Vasco (Spain) ..... [9525-15]

**Wafer warpage characterization measurement with modified fringe reflection method**, Po-Yi Chang, Yi-Sha Ku, Industrial Technology Research Institute (Taiwan) ..... [9525-46]

**Application of high-accuracy laser Doppler velocimeter in self-contained navigation**, Gao Chunfeng, Wei Guo, National Univ. of Defense Technology (China); Zhou Jian, Wang Qi, National University of Defense Technology (China); Xingwu Long, National Univ. of Defense Technology (China) ..... [9525-79]

**Design of photonic crystal fiber sensors for bio-medical applications**, Santosh Kumar, DIT Univ. (India); Akanksha Bisht, Ashish Bisht, Gurdeep Singh, DIT University (India); Angela Amphawan, Univ. Utara Malaysia (Malaysia) ..... [9525-80]

**Dimensional field testing of an optical measurement system in a long-span suspension bridge**, Luis F. Lages Martins, Nacional de Engenharia Civil (Portugal); José Manuel N. V. Rebordão, Univ. de Lisboa (Portugal); Álvaro S. Ribeiro, Nacional de Engenharia Civil (Portugal) ..... [9525-82]

**Principal component analysis based carrier removal approach for Fourier transform profilometry**, Shijie Feng, Qian Chen, Chao Zuo, Nanjing Univ. of Science and Technology (China) ..... [9525-83]

**Transparent layer thickness measurement using low-coherence interference microscopy**, Peter Kuehnhold, Univ. Kassel (Germany); Anton Nolvi, Univ. of Helsinki (Finland); Stanislav Tereschenko, Univ. Kassel (Germany); Ivan Kassamakov, Edward Hægström, Univ. of Helsinki (Finland); Peter Lehmann, Univ. Kassel (Germany) ..... [9525-84]

**Dynamic goniometer for industrial applications**, Elena Ivashchenko, Petr Pavlov, Saint Petersburg Electrotechnical Univ. "LETI" (Russian Federation) ..... [9525-85]

**3D structure stitching method for MEMS nondestructive detection with low overlap rate**, Long Ma, Dan Wang, Hong Yan Zhang, Yi Fan Niu, Civil Aviation Univ. of China (China); Tong Guo, Tianjin Univ. (China); Li Hua Lei, Shanghai Institute of Measurement and Testing Technology (China) ..... [9525-86]

**Analysis of adaptive laser scanning optical system with focus-tunable components**, Petr Pokorný, Antonín Mikš, Jiří Novák, Pavel Novák, Czech Technical Univ. in Prague (Czech Republic) ..... [9525-87]

**3D structure stitching method for MEMS nondestructive detection with large scope and low overlap rate**, Long Ma, Dan Wang, Hong Yan Zhang, Yi Fan Niu, Civil Aviation Univ. of China (China); Tong Guo, Tianjin Univ. (China); Li Hua Lei, Shanghai Institute of Measurement and Testing Technology (China) ..... [9525-88]

**Spatial filtering velocimeter for vehicle navigation with extended measurement range**, Xin He, Jian Zhou, Xiaoming Nie, Xingwu Long, National Univ. of Defense Technology (China) ..... [9525-89]

**Precision inspection of micro-components flatness by Moiré interferometry**, Saïd Meguellati, Univ. Ferhat Abbas de Sétif (Algeria) . [9525-90]

**Method of increasing the working distance of optical-electronic autocollimator**, Igor A. Konyakhin, Anastasia A. Moiseeva, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-91]

**The threshold sensitivity of the molecular condensation nuclei detector**, Vladimir D. Kuptsov, Saint-Petersburg State Polytechnical Univ. (Russian Federation); Vadim Y. Katelevisky, Neorganika (Russian Federation); Vladimir P. Valyukhov, Saint-Petersburg State Polytechnical Univ. (Russian Federation) ..... [9525-92]

**Special electronic distance meter calibration for precise engineering surveying industrial applications**, Jaroslav Braun, Martin Štroner, Rudolf Urban, Czech Technical Univ. in Prague (Czech Republic) ..... [9525-93]

**Dynamic processing of interferometric fringes parameters using stochastic algorithms: recent developments**, Maxim A. Volynsky, Igor P. Gurov, Pavel S. Skakov, Petr A. Ermolaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-94]

**Algorithm for recognition and measurement position of pitches on invar scale with submicron accuracy**, Oleg U. Lashmanov, Valery V. Korotae, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-99]



# CONFERENCE 9525

LOCATION: ROOM 14C

- Electrooptic converter to control linear displacements of the large structures of the buildings and facilities**, Aleksandr S. Vasilev, Igor A. Konyakhin, Alexander N. Timofeev, Oleg U. Lashmanov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Fedor V. Molev, OAO Avangard (Russian Federation) . . . . . [9525-101]
- High-speed and long-time FBG interrogation system using wavelength swept laser**, Tatsuya Yamaguchi, Yukitaka Shinoda, Nihon Univ. (Japan) . . . . . [9525-102]
- Electronic speckle pattern interferometry for fracture expansion in nuclear graphite based on PDE image processing methods**, Chen Tang, Junjiang Zhang, Chen Sun, Yonggang Su, Tianjin Univ. (China); Kai Leung Su, The Univ. of Hong Kong (Hong Kong, China) . . . . . [9525-103]
- Oil film interferometry technique for skin friction measurement in subsonic and supersonic flows**, Wei Wang, Chang Zhao, Minglei Yuan, Ke Wang, China Academy of Aerospace Aerodynamics (China) . . . . . [9525-104]
- Design for measurement of the polarization state of light based on division of wave front**, Hongwen Gao, Shaanxi Open Univ. (China); Chunmin Zhang, Xi'an Jiaotong Univ. (China) . . . . . [9525-105]
- Robust phase-shifting holography with high spatial resolution**, Igor A. Shevkunov, Nikolay V. Petrov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-106]
- Influence of video compression on the measurement error of the television system**, Alena Sotnik, Sergey N. Yarishev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Valeriy Korotaev, ITMO University (Russian Federation) . . . . . [9525-107]
- Evaluation of interference fringe parameters using sequential Monte Carlo method**, Petr A. Ermolaev, Maxim A. Volynsky, Pavel S. Skakov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-108]
- Fast inspection of bulk and surface defects of large aperture optics in high power lasers**, Yuanan Zhao, Guohang Hu, Shijie Liu, Kui Yi, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [9525-109]
- Enhanced adjustment methods for optical rotary encoders**, Nikolai V. Smirnov, Svyatoslav M. Latyev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); René Theska, Technische Univ. Ilmenau (Germany) . . . . . [9525-110]
- Investigation on measurement of mid-frequency wavefront error for large optics in high-power laser system**, Shijie Liu, Chunxiang Jin, You Zhou, Yunbo Bai, Yuanan Zhao, Kui Yi, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [9525-111]
- Phase disturbing speckle-suppressing method in fiber metrology under coherent illumination**, Weimin Sun, Yunxiang Yan, Jing Wang, Hongyuan Fu, He Tian, Yongjun Liu, Harbin Engineering Univ. (China) . . . . . [9525-112]
- Generalized phase-shifting algorithms: error analysis**, Gastón A. Ayubi, Univ. de la República (Uruguay) . . . . . [9525-113]
- Testing techniques for large aspheric primary mirrors in grinding**, Yongqian Wu, Gaofeng Wu, Yundong Zhang, Institute of Optics and Electronics (China) . . . . . [9525-114]
- Uncertainty reduction of light spot angular position estimation in optical measurement system based on quadrant photodiode**, Evgeni G. Lebedko, Kirill V. Trifonov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-115]
- An approach to defect inspection for packing presswork with virtual orientation points and threshold template image**, Xiangyang Hao, Songlin Liu, Zhao Fulai, Lixing Jiang, Zhengzhou Institute of Surveying and Mapping (China) . . . . . [9525-116]
- Short wavelengths active bichromatic pulsed pyrometer for solids and liquids designed for measurements in harsh environments**, Loris Navello, Univ. Paris Ouest Nanterre La Défense (France); Jeremy Lebedinsky, Lasur SARL (France); Julien Pierre Offret, Bruno Serio, Tanguy Davin, Univ. Paris Ouest Nanterre La Défense (France); Yannick Bailly, Univ. de Technologie de Belfort-Montbéliard (France); Philippe J. L. Hervé, Univ. Paris Ouest Nanterre La Défense (France) . . . . . [9525-117]
- Sapphire fiber optic sensor for hot flow temperature analysis**, Wei Wang, Yuanhong Wang, Minglei Yuan, China Academy of Aerospace Aerodynamics (China) . . . . . [9525-118]
- Determination of the refractive index of particles by using wavelength immersion matching technique**, Ilpo O. Niskanen, Univ. of Oulu (Finland) . . . . . [9525-119]
- Optical detection of microorganisms dispersed in pure water**, Ayata Takami, Takeshi Ishiyama, Toyohashi Univ. of Technology (Japan) . . . . . [9525-120]
- Integration of an intensity-modulated optical fiber temperature sensor into ceramic coating obtained by wire flame thermal spray**, Duo Yi, Univ. de Technologie de Belfort-Montbéliard (France); Pierre Pfeiffer, Univ. de Strasbourg (France); Bruno Serio, Univ. Paris Ouest Nanterre La Défense (France); Sophie Costil, Univ. de Technologie de Belfort-Montbéliard (France) . . . . . [9525-121]
- Measurement of concentration of sugar in solutions with laser speckle decorrelation**, Swapnil Mahajan, Vismay Trivedi, Vani K. Chhaniwal, The Maharaja Sayajirao Univ. of Baroda (India); Mahendrakumar P. Prajapati, P D Pandya Mahila Commerce College (India); Zeev Zalevsky, Bar-Ilan Univ. (Israel); Bahram Javidi, Univ. of Connecticut (United States); Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India) . . . . . [9525-122]
- Precise angular position measurement of a point source in an optoelectronic system with CCD arrays upon a single readout**, Evgeny G. Lebedko, Elena Zvereva, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-123]
- Cost effective spectral sensor solutions for hand held and field applications**, Edgar Reetz, Martin Correns, Technische Univ. Ilmenau (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) . . . . . [9525-124]
- Integration of an autonomous optical sensor system in the machining area of milling centers**, Marc Preißler, Mathias Schellhorn, Rolf Hoffmann, Gunther Notni, Technische Univ. Ilmenau (Germany) . . . . . [9525-125]
- Quantifying height of machined steps on copper disk using Fourier domain short coherence interferometer**, Risto Montonen, Helsinki Institute of Physics (Finland) and Univ. of Helsinki (Finland); Ivan Kassamakov, Edward Haeggström, Univ. of Helsinki (Finland); Kenneth Österberg, Helsinki Institute of Physics (Finland) . . . . . [9525-126]
- The research of the nonexcluded air control error component using the optical-electronic system based on the dispersion method**, Ivan S. Nekrylov, Alexandr N. Timofeev, Sergey N. Yarishev, Anton V. Nikulin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-127]
- The definition of the railway position control error in the plane and profile using the optical-electronic system**, Anton V. Nikulin, Aleksandr N. Timofeev, Ivan S. Nekrylov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-128]
- Aberration influence on accuracy of angle measurements by means of autocollimator**, Yuri V. Filatov, Roman A. Larichev, Saint Petersburg Electrotechnical Univ. "LETI" (Russian Federation) . . . . . [9525-129]
- Measurement of in-plane rotation angle by sampling Moiré technique**, Soheila Javadianvarjovi, Amirkabir Univ. of Technology (Iran, Islamic Republic of); Khosro Madanipour, Amirkabir Univ. (Iran, Islamic Republic of) . . . . . [9525-130]
- Monitoring of deep-sea industrial facilities using fiber optic cable**, Valery V. Korotaev, Victor M. Denisov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Joel J. P. C. Rodrigues, Instituto de Telecomunicações (Portugal) and Univ. of Beira Interior (Portugal); Mariya G. Serikova, Andrey V. Timofeev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-131]
- Wavelength dependency of the Total Integrated Scattering (TIS) method in surface roughness measurements**, Sepehr Razi, Iran Univ. of Science and Technology (Iran, Islamic Republic of); Khosro Madanipour, Amirkabir Univ. of Technology (Iran, Islamic Republic of); Mahmoud Mollabashi, Iran Univ. of Science and Technology (Iran, Islamic Republic of) . . . . . [9525-132]
- Roughness measurement of nanofiber webs by using of light scattering technique**, Masoumeh Taghizadeh, Khosro Madanipour, Masoud Latifi, Amirkabir Univ. of Technology (Iran, Islamic Republic of) . . . . . [9525-134]
- The choice of marks for systems with noncontact position control**, Valery V. Korotaev, Maksim A. Kleshchenok, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9525-136]
- Improving the resolution in phase-shifting Gabor holography by CCD shift**, Luis Granero-Montagud, Vicente Micó, Univ. de València (Spain); Zeev Zalevsky, Bar-Ilan Univ. (Israel); Javier García, Univ. de València (Spain); Bahram Javidi, University of Connecticut (United States) . . . . . [9525-137]
- Rapid detection of delamination areas in laminated structural elements by means of optically monitored strain solitons**, Irina V. Semenova, Ioffe Physical-Technical Institute (Russian Federation); Andrey V. Belashov, Ioffe Physical-Technical Institute (Russian Federation) and National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Galina V. Dreiden, Ioffe Physical-Technical Institute (Russian Federation); Nickolai V. Petrov, ITMO University (Russian Federation); Alexander M. Samsonov, Ioffe Physical-Technical Institute (Russian Federation) . . . . . [9525-138]
- Diffusivity measurement using compact low cost field portable device based on light deflection**, Vani K. Chhaniwal, Swapnil Mahajan, Vismay Trivedi, Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India) . . . . . [9525-139]
- GPUs benchmarking in subpixel image registration algorithm**, Martin Sanz, Univ. de València (Spain); Jose Angel Picazo-Bueno, Univ. de València (Spain); Vicente Micó, Univ. de València (Spain); Carlos Ferrerira, Univ. de València (Spain); Luis Granero, Univ. de Valencia (Spain); Javier Garcia, Univ. de València (Spain) . . . . . [9525-140]
- Remote sensing of temperature and concentration profiles of a gas jet by coupling infrared emission spectroscopy and LIDAR for characterization of aircraft engine exhaust**, Julien Pierre Offret, Univ. Paris Ouest Nanterre La Défense (France); Jeremy Lebedinsky, Lasur SARL (France); Loris Navello, Vincent Pina, Bruno Serio, Univ. Paris Ouest Nanterre La Défense (France); Yannick Bailly, Univ. de Technologie de Belfort-Montbéliard (France); Philippe J. L. Hervé, Univ. Paris Ouest Nanterre La Défense (France) . . . . . [9525-141]



**Experimental measurement of group velocity dispersion during operation in cladding-pumped large-mode-area Yb-doped fibers**, Tobias Baselt, Christopher Taudt, Westsächsische Hochschule Zwickau (Germany); Andrés-Fabián Lasagni, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) ..... [9525-142]

**Optic-electronic system for measuring the three-dimensional angular deformation of pipe sections at large constructions**, Igor A. Konyakhin, Van Phong Hoang, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Yury Artemenko, P.N. Lebedev Physical Institute (Russian Federation); Renpu Li, Andrey A. Smekhov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-143]

**Parallelism measurement of plane glass at oblique incidence by interferometers**, Yi Yang, Huan Ren, China Academy of Engineering Physics (China) ..... [9525-144]

**Optical-electronic system for real-time position control of roof's supporting structure**, Sergey V. Mikheev, Igor A. Koniakhine, Oleg Barsukov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-145]

**Autocollimating systems for roll angle measurement of large-scale object deformation**, Tatyana V. Turgalieva, Igor A. Konyakhin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-146]

**Analysis of Fourier-based digital microscopy holography systems for retrieval of phase objects**, Alfonso Padilla-Vivanco, Martin Hernández-Romo, Carina Toxqui-Quiti, Univ. Politécnica de Tulancingo (Mexico) ..... [9525-147]

**Measurement of plasma parameter in Dielectric Barrier Discharge (DBD) by Moiré deflectometry technique**, Fatemeh Salimi Meidanshahi, Mahfanavar Co. (Iran, Islamic Republic of); Khosro Madanipour, Amirkabir Univ. of Technology (Iran, Islamic Republic of); Babak Shokri, Shahid Beheshti Univ. (Iran, Islamic Republic of); Mohammad Reza Khani, Hamid Razavi Borzoki, Shahid Beheshti University (Iran, Islamic Republic of) ..... [9525-148]

**Research and development objectives for the spectral coherence tomography**, Dmitriy I. Yegorov, National Research Univ. of ITMO (Russian Federation); E. A. Tsyganok, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-149]

**The TiO<sub>2</sub> nanoparticles concentration assessment in polymer matrix using OCT technique**, Michal Trojanowski, Maciej Kraszewski, Marcin R. Strakowski, Paulina Strakowska, Gdansk Univ. of Technology (Poland) ..... [9525-150]

**Application of Fresnel diffraction from a 2D array of reflective disks in optical profilometry of a flat surface**, Ahmad Darudi, Pegah Asgari, Yousef Pourvais, Univ. of Zanjan (Iran, Islamic Republic of) ..... [9525-151]

**Optical coherence tomography for ceramic tableware inspection**, Maciej Kraszewski, Michal Trojanowski, Marcin R. Strakowski, Gdansk Univ. of Technology (Poland) ..... [9525-152]

**A two-wavelength digital microscopy holography system based on a Mach-Zender interferometer**, Martin Hernandez-Romo, Alfonso Padilla-Vivanco, Carina Toxqui-Quiti, Univ. Politécnica de Tulancingo (Mexico) ..... [9525-153]

**Applying of digital signal processing to optical equisignal zone system**, Anton A. Maraev, Aleksandr N. Timofeev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Vadim F. Gusarov, ITMO University (Russian Federation) ..... [9525-155]

**System for deflection measurements of floating dry docks**, Alexey A. Gorbachev, Anton V. Pantyushin, Mariya G. Serikova, Valery V. Korotaev, Aleksandr N. Timofeev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-156]

**360-degree three-dimensional shape measurement system: applications in oil industry**, Carlos Ricardo Contreras Pico, Univ. Industrial de Santander (Colombia) and Univ. Santo Tomás (Colombia); Javier R. Arciniegas, Jaime Enrique Meneses Fonseca, Univ. Industrial de Santander (Colombia) ..... [9525-157]

**360-degree three-dimensional digitization of human torso by using multiples projection-acquisition systems**, Carlos Ricardo Contreras Pico, Univ. Industrial de Santander (Colombia) and Univ. Santo Tomás (Colombia); Jaime Enrique Meneses Fonseca, Univ. Industrial de Santander (Colombia) ..... [9525-158]

**Evaluation of focal length of a lens using the Lau effect**, Mohammad Abolhassani, Arak Univ. (Iran, Islamic Republic of) ..... [9525-159]

**Potential use of the characteristic Raman lines of toluene (C<sub>7</sub>H<sub>8</sub>) as a reference on the spectral analysis of fuel blends**, Valentin Ortega Clavero, Andreas Weber, Werner W. Schröder, Dan Curticepan, Hochschule Offenburg (Germany) ..... [9525-160]

**Monitoring industrial facilities using principles of integration of fiber classifier and local sensor networks**, Valery V. Korotaev, Victor M. Denisov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Joel J. P. C. Rodrigues, Instituto de Telecomunicações (Portugal) and National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Mariya G. Serikova, Andrey V. Timofeev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-162]

**Length characterization of a piezoelectric actuator travel with a mode-locked femtosecond laser**, Lenka Pravdova, Adam Lešundák, Václav Hucl, Martin Čížek, Břetislav Mikel, Jan Hrabina, Šimon Řeřucha, Ondřej Číp, Josef Lazar, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic) ..... [9525-164]

**Preparation of optical frequency references based on gas filled hollow core photonics crystal fibers**, Miroslava Hola, Břetislav Mikel, Jan Hrabina, Josef Lazar, Ondřej Číp, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic) ..... [9525-165]

**Industrial interferometry systems for multi-axis measurement**, Jindrich Oulehla, Miroslava Hola, Jan Hrabina, Josef Lazar, Ondřej Číp, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic); Miloslav Vychodil, Petr Sedlár, Milan Provaznik, Meopta - optika, s.r.o. (Czech Republic) [9525-166]

**Narrow-linewidth tunable laser working at 633 nm suitable for industrial interferometry**, Tuan Pham Minh, Václav Hucl, Martin Čížek, Břetislav Mikel, Jan Hrabina, Šimon Řeřucha, Ondřej Číp, Josef Lazar, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic) ..... [9525-167]

**Multipath interference characterization of bend-insensitive fibers for short-reach optical communications**, Massimo Olivero, Guido Perrone, Renato Orta, Alberto Vallan, Politecnico di Torino (Italy); L. Gregorio, Telecom Italia (Italy); P. Regio, Telecom Italia Lab. (Italy); Paolo Pellegrino, Telecom Italia (Italy) ..... [9525-168]

## WEDNESDAY 24 JUNE

### SESSION 8

LOCATION: ROOM 14C ..... WED 8:00 TO 10:00

### Fringe Projection and 3D Imaging

Session Chair: **Matias R. Viotti**, Univ. Federal de Santa Catarina (Brazil)

8:00: **Automatic complete high-precision optical 3D measurement of air cooling-holes of gas turbine vanes for repair**, Christoph Munkelt, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Lars Aschermann, Frank Seidel, MTU Maintenance Hannover GmbH (Germany) ..... [9525-37]

8:20: **Endoscopic fringe projection for in-situ inspection of a sheet-bulk metal forming process**, Steffen Matthias, Markus Kästner, Eduard Reithmeier, Leibniz Univ. Hannover (Germany) ..... [9525-38]

8:40: **Long wave infrared 3D scanner**, Ernst Wiedenmann, Mohsen Afrough, Sven Albert, Robert Schott, Jan Tusch, Andreas Wolf, Aimess Services GmbH (Germany) ..... [9525-39]

9:00: **Experimental comparison of laser speckle projection and array projection for high-speed 3D measurements**, Stefan Heist, Peter Lutzke, Patrick Dietrich, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) ..... [9525-40]

9:20: **Development of a photogrammetry system for the measurement of rotationally symmetric forgings**, Aneta Zatocilova, David Paloušek, Jan Brandejs, Brno Univ. of Technology (Czech Republic) ..... [9525-41]

9:40: **3D shearography with integrated structured light projection for strain inspection of curved objects**, Andrei G. Anisimov, Roger M. Groves, Technische Univ. Delft (Netherlands) ..... [9525-42]

Coffee Break ..... Wed 10:00 to 10:30

### PLENARY SESSION

LOCATION: SAAL 1 ..... WED 10:30 TO 11:25

### Extreme Computational Imaging: Photography, Health-tech and Displays

**Ramesh Raskar**, MIT Media Lab., United States

# CONFERENCE 9525

LOCATION: ROOM 14C

## SESSION 9

LOCATION: ROOM 14C ..... WED 11:30 TO 12:50

### Deflectometry

Session Chair: **Gunther Notni**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany)

11:30: **Temporal modulated deflectometry for painted surface inspection**, Toru Kurihara, Kochi Univ. of Technology (Japan); Shigeru Ando, The Univ. of Tokyo (Japan); Michihiko Yoshimura, Ricoh Elemex Corp. (Japan) ..... [9525-43]

11:50: **Point-based deflectometry for measuring optical freeform topographies**, Carsten Glasenapp, Carl Zeiss AG (Germany) ..... [9525-45]

12:10: **Three dimensional reconstruction of human torso using a portable multiview fringe projection device**, Jaime Enrique Meneses Fonseca, Andrés L. González Gómez, Univ. Industrial de Santander (Colombia) ..... [9525-161]

12:30: **A Non-scanning Reflection Technique (NRT) for measurements of optical nonlinearities**, Lin Zhang, Huan Ren, Yi Yang, Quan Yuan, Yong Liu, Zhendong Shi, Hua Ma, Bo Chen, China Academy of Engineering Physics (China); Tingkui Mu, Xi'an Jiaotong Univ. (China) ..... [9525-100]

Lunch Break ..... Wed 12:50 to 13:45

## SESSION 10

LOCATION: ROOM 14C ..... WED 13:45 TO 15:30

### Joint Session I: Measurement of Optical Components and Systems

Session Chairs: **Jean-Michel Asfour**, Dioptric GmbH (Germany); **Christof Pruss**, Institut für Technische Optik (Germany)

#### Joint Session with EOS conference on Manufacturing and Testing of Optical Components

13:45: **Never-ending struggles with mid-spatial frequencies** (*Invited Paper*), Gregory W Forbes, QED Technologies (Australia) and University of North Carolina at Charlotte (United States) ..... [9525-47]

14:30: **Calibration and control of wavefront errors in measurements of cylindrical optics**, Florian Wolfgramm, Jan-Peter P. Richters, Rainer Schuhmann, Berliner Glas KGaA Herbert Kubatz GmbH & Co. (Germany) ..... [9525-48]

14:50: **Overview of characterization and metrology techniques for microlenses and microlens arrays**, Myun-Sik Kim, Lisa Allegre, Jonathan Sunarjo, Wilfried Noell, Reinhard Völkel, SUSS MicroOptics SA (Switzerland) ..... [9525-49]

15:10: **Wavefront calibration in 3D space**, Johannes Schindler, Goran Bastian Baer, Univ. Stuttgart (Germany); Christof Pruss, Wolfgang Osten, Institut für Technische Optik (Germany) ..... [9525-50]

Coffee Break ..... Wed 15:30 to 16:00

## SESSION 11

LOCATION: ROOM 14C ..... WED 16:00 TO 18:10

### Joint Session II: Measurement of Optical Components and Systems

Session Chairs: **Jean-Michel Asfour**, Dioptric GmbH (Germany); **Christof Pruss**, Institut für Technische Optik (Germany)

#### Joint Session with EOS conference on Manufacturing and Testing of Optical Components

16:00: **Traceability in interferometric form metrology** (*Invited Paper*), Michael Schulz, Physikalisch-Technische Bundesanstalt (Germany); Gernot Blobel, Physikalisch-Technische Bundesanstalt (Germany); Ines Fortmeier, Manuel Stavridis, Clemens Elster, Physikalisch-Technische Bundesanstalt (Germany) ..... [9525-51]

16:30: **New method for optical shape measurement of refractive surfaces**, Mohamed Bichra, Florian Schurig, Stefan Sinzinger, Technische Univ. Ilmenau (Germany) ..... [9525-52]

16:50: **Through-focus OTF-based alignment testing of whole slide imaging systems**, S. Mojtaba Shakeri, Technische Univ. Delft (Netherlands); Bas Hulsken, Philips Digital Pathology (Netherlands); Lucas J. van Vliet, Sjoerd Stallinga, Technische Univ. Delft (Netherlands) ..... [9525-53]

17:10: **Unique characteristics of the fiber optic reference technique in absolute cylindrical testing**, Ayshah Alatawi, Patrick J. Reardon, The Univ. of Alabama in Huntsville (United States) ..... [9525-54]

17:30: **Measurement of aspheric and freeform optical surfaces with Diffractive Null Lenses with and without integrated Fizeau reference surface**, Alexander Grigorievich Poleshchuk, Institute of Automation and Electrometry (Russian Federation); Jean-Michel Asfour, Dioptric GmbH (Germany); Victor P. Korolkov, Ruslan K. Nasyrov, Institute of Automation and Electrometry (Russian Federation); Frank Weidner, Dioptric GmbH (Germany) ..... [9525-55]

17:50: **Point diffraction interferometry based on the use of two pinholes**, Nikolay B. Voznesenskiy, VTT-NTM OÜ (Estonia); Dongmei Ma, Chunshui Jin, Haitao Zhang, Jie Yu, Changchun Institute of Optics, Fine Mechanics and Physics (China); Mariia Voznesenskaia, Tatiana Voznesenskaia, VTT-NTM OÜ (Estonia); Wenlong Zhang, Changchun Institute of Optics, Fine Mechanics and Physics (China) ..... [9525-56]

## THURSDAY 25 JUNE

### SESSION 12

LOCATION: ROOM 14C ..... THU 8:10 TO 10:00

### 3D Shape, Displacement, and Deformation Measurement

Session Chair: **Jürgen W. Czarske**, Technische Univ. Dresden (Germany)

8:10: **Speckle interferometry in the long-wave infrared for combining holography and thermography in a single sensor: applications to nondestructive testing: The FANTOM Project** (*Invited Paper*), Marc P Georges, Univ. de Liège (Belgium) ..... [9525-57]

8:40: **Problems and solutions in measurements of engineering objects by means of digital image correlation**, Marcin Malesa, Malgorzata Kujawirska, Warsaw Univ. of Technology (Poland) ..... [9525-58]

9:00: **Objective speckle displacement resulting from the deformation of shaped objects**, Thomas O. H. Charrett, Ralph P. Tatam, Cranfield Univ. (United Kingdom) ..... [9525-59]

9:20: **Optical system for the calibration and verification of correct axis positioning in medium-big sized milling boring machines**, Marcomattia Mocellin, Massimo Fedel, Lorenzo Cocola, CNR-IFN UoS Padova (Italy); Renzo Casarin, FPT Industrie S. P. A. (Italy); Luca Poletto, CNR-IFN UoS Padova (Italy) ..... [9525-60]

9:40: **Modified coherent gradient sensing method for slope measurement of reflective surfaces**, Kang Ma, Huimin Xie, Tsinghua Univ. (China) ..... [9525-61]

Coffee Break ..... Thu 10:00 to 10:30

### SESSION 13

LOCATION: ROOM 14C ..... THU 10:30 TO 13:00

### Nondestructive Testing and In-process Measurement

Session Chair: **Marc P. Georges**, Univ. de Liège (Belgium)

10:30: **Profilometry and interferometry in life science applications** (*Invited Paper*), Joris Dirckx, Univ. Antwerpen (Belgium) ..... [9525-62]

11:00: **Optical detection of mixture ratios and impurities in viscous materials based on fluorescence imaging**, Patrik J. Murr, Anton J. Tremmel, Michael Schardt, Alexander W. Koch, Technische Univ. München (Germany) ..... [9525-63]

11:20: **Expanded beam spectro-ellipsometry for big area on-line monitoring**, Miklos Fried, Csaba Major, Gyorgy Juhasz, Peter Petrik, Research Institute for Technical Physics and Materials Science (Hungary); Zoltan G. Horvath, MTA EK MFA (Hungary) ..... [9525-64]

11:40: **Additive manufacturing: a new approach for individualized optical shape metrology**, Andreas Heinrich, Philippe Maillard, Anne Suckow, Hochschule Aalen (Germany); Andrzej Grzesiak, Carl Zeiss Industrial Metrology (Germany); Peter Sorg, Uwe Berger, Hochschule Aalen (Germany) ..... [9525-65]

12:00: **3D shape measurements with a single interferometric sensor for in-situ lathe monitoring**, Robert Kuschmierz, Yongle Huang, Jürgen W. Czarske, Technische Univ. Dresden (Germany); Stephan Metschke, Physikalisch-Technische Bundesanstalt (Germany); Frank Löffler, Physikalisch-Technische Bundesanstalt (Germany); Andreas Fischer, Technische Univ. Dresden (Germany) ..... [9525-66]

12:20: **Ultrafast 2K line-scan sensor for industrial inspection applications**, Christian Nitta, Benjamin Bechen, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany); Ernst Bodenstorfer, Joerg Brodersen, Konrad J. Mayer, AIT Austrian Institute of Technology GmbH (Austria); Werner Brockherde, Olaf M. Schrey, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany) ..... [9525-67]

12:40: **Monitoring deformations of industrial objects using optical-electronic autoreflection system**, Igor A. Konyakhin, Maksim A. Kleshchenok, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9525-68]

Lunch Break ..... Thu 13:00 to 13:50

## SESSION 14

LOCATION: ROOM 14C ..... THU 13:50 TO 15:30

### Vibration Measurement

Session Chair: **Joris Dirckx**, Univ. Antwerpen (Belgium)

13:50: **High-speed digital in-line holography as multipoint vibrometry to analyze vibrations of structures**, Julien Poittevin, IRT Jules Verne (France); Pascal Picart, François Gautier, Charles Pézerat, Univ. du Maine (France) ..... [9525-69]

14:10: **Ultraprecise vibrometry measurement with nanometric accuracy using optical feedback**, Ajit Jha, Francisco J. Azcona Guerrero, Santiago Royo, Univ. Politècnica de Catalunya (Spain) ..... [9525-70]

14:30: **Evaluation of the vibrational behaviour of a rotating disk by optical tip-clearance measurements**, Iker García, Joseba Zubia Zaballa, Univ. del País Vasco (Spain); Josu Beloki, Aeronautical Technologies Ctr. (Spain); Jon Arrue, Univ. del País Vasco (Spain); Joel Villatoro, Univ. del País Vasco (Spain) and IKERBASQUE. Basque Foundation for Science (Spain) ..... [9525-71]

14:50: **Simultaneous laser vibrometry on multiple surfaces with a single beam system using range-resolved interferometry**, Thomas Kissinger, Thomas O. H. Charrett, Stephen W. James, Cranfield Univ. (United Kingdom); Alvin Adams, Andrew Twin, Oxford Instruments plc (United Kingdom); Ralph P. Tatam, Cranfield Univ. (United Kingdom) ..... [9525-72]

15:10: **Multi-point laser coherent detection system and its application on vibration measurement**, Yu Fu, Nanyang Technological Univ. (Singapore); Chong Yang, China Academy of Engineering Physics (China); Yingjun Xu, Southeast Univ. (China); Huan Liu, Keyu Yan, Guo Min, Nanyang Technological Univ. (Singapore) ..... [9525-73]

Coffee Break ..... Thu 15:30 to 16:00

## SESSION 15

LOCATION: ROOM 14C ..... THU 16:00 TO 17:40

### Defect Detection

Session Chair: **Armando Albertazzi Gonçalves Jr.**, Univ. Federal de Santa Catarina (Brazil)

16:00: **Realistic simulation of camera images of local surface defects in the context of multi-sensor inspection systems**, Haiyue Yang, Univ. Stuttgart (Germany); Tobias Haist, Marc Gronle, Wolfgang Osten, Univ. of Stuttgart (Germany) ..... [9525-74]

16:20: **Discrete Modal Decomposition for surface appearance modelling and rendering**, Gilles Pitard, Univ. de Savoie (France); Gaëtan Le Goïc, Laboratoire Electronique, Informatique et Image LE2I UMR CNRS 6306 Univ. de Bourgogne (France); Hugues Favrelière, Laboratoire Systèmes et Matériaux pour la Mécatronique, SYMME EA 4144, Univ. de Savoie (France); Serge Samper, Laboratoire de Recherche en Mécanique Appliquée, LARMAUR - ERL CNRS 6274, Univ. de Rennes (France); Simon-Frédéric Désage, Maurice Pillet, Laboratoire Systèmes et Matériaux pour la Mécatronique, SYMME EA 4144, Univ. de Savoie (France) ..... [9525-75]

16:40: **Using speckle images correlation for real-time inspection of fatigue crack initiation and propagation**, Alexander P. Vladimirov, Ivan Kamantsev, Valeriya E. E. Veselova, Sergey Gladkovskiy, Institute of Engineering Science (Russian Federation) ..... [9525-77]

17:00: **Smart optical distance sensor for automatic welding detection**, Michael Kahl, Stefan Rinner, Andreas Ettemeyer, Interstaatliche Hochschule für Technik Buchs NTB (Switzerland) ..... [9525-35]

17:20: **In-line polariscopic checking of plastic molded-injected lenses: preliminary results**, Josep Arasa, Univ. Politècnica de Catalunya (Spain); Daniel Mayershofer, Hochschule Aalen (Germany); Jordi Romero, Fondació ASCAMM (Spain) ..... [9525-81]

# CONFERENCE 9526

LOCATION: ROOM 3

Monday–Thursday 22–25 June 2015 • Proceedings of SPIE Vol. 9526

## Modeling Aspects in Optical Metrology V

Conference Chair: **Bernd Bodermann**, Physikalisch-Technische Bundesanstalt (Germany)

Conference Co-Chairs: **Karsten Frenner**, Institut für Technische Optik (Germany); **Richard M. Silver**, National Institute of Standards and Technology (United States)

Programme Committee: **Markus Bär**, Physikalisch-Technische Bundesanstalt (Germany); **Jörg Bischoff**, Osires Optical Engineering (Germany); **Harald Bosse**, Physikalisch-Technische Bundesanstalt (Germany); **Sven Burger**, Konrad-Zuse-Zentrum für Informationstechnik (Germany); **Peter Evanschitzky**, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); **Christian Hafner**, ETH Zürich (Switzerland); **Wolfgang Holzapfel**, DR. JOHANNES HEIDENHAIN GmbH (Germany); **Bernd H. Kleemann**, Carl Zeiss AG (Germany); **Wolfgang Osten**, Institut für Technische Optik (Germany); **Andreas Rathsfeld**, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); **Thomas Scherübl**, Carl Zeiss SMS GmbH (Germany); **Patrick Schiavone**, Aselta Nanographics (France); **Irwan D. Setija**, ASML Netherlands B.V. (Netherlands); **Michael Totzeck**, Carl Zeiss AG (Germany); **Jari Turunen**, Univ. of Eastern Finland (Finland); **Frank Wyrowski**, Friedrich-Schiller- Univ. Jena (Germany)

### MONDAY 22 JUNE

#### JOINT SESSION

LOCATION: SAAL 1 ..... MON 17:00 TO 18:30

#### Computational Photonics for Metrology Applications

Session Chair: **Bernd Bodermann**, Physikalisch-Technische Bundesanstalt (Germany)

Joint Session: SPIE Optical Metrology - CLEO EQEC 2015 Invited Speakers

17:00: **Motion contrast 3D scanning** (*Invited Paper*), Oliver Cossairt, Northwestern Univ. (United States) ..... [9526-100]

17:30: **Analysis of bi-periodic composite materials made of stacks of tilted one-dimensional arrays of rods** (*Invited Paper*), Gérard Granet, Univ. Blaise Pascal (France) ..... [9526-101]

18:00: **Nonlocal light-matter interactions in noble-metal and graphene nanostructures** (*Invited Paper*), N. Asger Mortensen, DTU Fotonik (Denmark) ..... [9526-102]

Coffee Break ..... Tue 10:00 to 10:30

### TUESDAY 23 JUNE

#### OPENING REMARKS

LOCATION: ROOM 3 ..... TUE 8:40 TO 8:50

Session Chair: **Bernd Bodermann**, Physikalisch-Technische Bundesanstalt (Germany)

#### SESSION 1

LOCATION: ROOM 3 ..... TUE 8:50 TO 10:00

#### Scatterometry I

Session Chair: **Sven Burger**, JCMwave GmbH (Germany)

8:50: **Enlarging applicability domain of the C method with piecewise linear parameterization: gratings of deep and smooth profiles** (*Invited Paper*), Xihong Xu, Lifeng Li, Tsinghua Univ. (China) ..... [9526-1]

9:20: **Specialized scatterometry methods for two types of gratings with distinct groove profiles**, Lin Yang, Tsinghua Univ. (China) ..... [9526-2]

9:40: **Spatial mode projection for side-wall angle measurements**, Luca Cisotto, Technische Univ. Delft (Netherlands); Yan Zhu, Delft University of Technology (Netherlands); Sylvania F. Pereira, H. Paul Urbach, Technische Univ. Delft (Netherlands) ..... [9526-3]

Coffee Break ..... Tue 10:00 to 10:30

#### SESSION 2

LOCATION: ROOM 3 ..... TUE 10:30 TO 12:20

#### Interferometry and Phase I

Session Chair: **Christof Pruss**, Institut für Technische Optik (Germany)

10:30: **Phase error analysis and compensation in fringe projection profilometry** (*Invited Paper*), Christian Bräuer-Burchardt, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) ..... [9526-4]

11:00: **Signal simulation method for homodyne multiple target interferometers using short coherence length laser sources**, Maik Fox, Thorsten Beuth, Karlsruher Institut für Technologie (Germany); Andreas Streck, ELOVIS GmbH (Germany); Wilhelm Stork, Karlsruher Institut für Technologie (Germany) ..... [9526-8]

11:20: **Metrological characterization of a large aperture Fizeau for x-ray mirrors measurement**, Maurizio Vannoni, Idoia Freijo Martin, European XFEL GmbH (Germany) ..... [9526-7]

11:40: **An application of compressed sensing for apple-core distortion in tomographic digital holographic microscope**, Li-Chien Lin, Feng Chia Univ. (Taiwan) ..... [9526-9]

12:00: **A way for measuring the relationship between DM surface and wave-front aberrations in a beam rotate-90° laser system**, Ping Yang, Institute of Optics and Electronics (China); Mingwu Ao, Univ. of Electronic Science and Technology of China (China); Shuai Wang, Lizhi Dong, Institute of Optics and Electronics (China); Yi Tan, Institute of Optics and Electronics, Chinese Academy of Sciences, (China) and Institute of Optics and Electronics, Chinese Academy of Sciences (China) ..... [9526-6]

Lunch Break ..... Tue 12:20 to 14:20

#### SESSION 3

LOCATION: ROOM 3 ..... TUE 14:20 TO 15:30

#### Radiometry and Photometry

Session Chair: **Liwei Fu**, Univ. Stuttgart (Germany)

14:20: **Optical detectors based on thermoelastic effect in crystalline quartz** (*Invited Paper*), Vladimir P. Chelibanov, JSC OPTEC (Russian Federation); G. G. Ishanin, ITMO Univ. (Russian Federation) ..... [9526-10]

14:50: **Radiometric uncertainty for spectrally broadband measurements of absolute mid-wave infrared radiance under variable ambient conditions**, Thomas Svensson, Swedish Defence Research Agency (Sweden); Henrik Larsson, Linköping Univ. (Sweden); Johan Eriksson, Swedish Defence Research Agency (Sweden) ..... [9526-13]

15:10: **Numerical modeling and uncertainty analysis of light emitting diodes for photometric measurements**, Mohammed Zia Ullah Khan, Mohammed T. Abbas, Luai Mohammed Al-Hadhrani, King Fahd Univ. of Petroleum and Minerals (Saudi Arabia) ..... [9526-11]

Coffee Break ..... Tue 15:30 to 16:00



### SESSION 4

LOCATION: ROOM 3 ..... TUE 16:00 TO 18:00

#### Optical Systems

Session Chair: **Wolfgang Holzappel**,  
DR. JOHANNES HEIDENHAIN GmbH (Germany)

16:00: **Horizontal geometrical reaction time model for two-beam nacre-like LIDARS**, Thorsten Beuth, Maik Fox, Wilhelm Stork, Karlsruhe Institut für Technologie (Germany) ..... [9526-14]

16:20: **Investigation vignetting beams in optoelectronic autocollimation angle measurement system**, Igor A. Konyakhin, Aiganyam Sakhariyanova, Andrey A. Smekhov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-15]

16:40: **Transferring the Rb<sup>+</sup> hyperfine-structure stability to a Fabry-Perot resonator used as a frequency standard for astronomical spectrographs**, Philipp Huke, Hanno Holzthüter, Ansgar Reiners, Univ. Göttingen (Germany) ..... [9526-19]

17:00: **Fully-vectorial simulation and tolerancing of optical systems for wafer inspection by field tracing**, Daniel Asoubar, Hagen Schweitzer, Christian Hellmann, Michael Kuhn, LightTrans Virtual Lab UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) ..... [9526-17]

17:20: **Wide-aperture laser beam measurement using transmission diffuser: errors modeling**, Ivan Matsak, S.P. Korolev Rocket and Space Corp. Energia (Russian Federation) ..... [9526-18]

17:40: **Application of the ARMA model in distributed fiber vibration sensing system**, Hongyan Wu, Haiyan Xu, HeKuo Peng, Fudan Univ. (China) .. [9526-16]

### POSTERS—TUESDAY

LOCATION: ICM FOYER ..... TUE 18:00 TO 19:00

Conference attendees are invited to attend the Optical Metrology Poster Session on Tuesday afternoon. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 10:00 hrs on Tuesday through 12:00 hrs on Thursday.

Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**Determination of refractive index by Moiré deflectometry**, Mohammad Ahmadi, Khosro Madanipour, Soheila Javadianvarjovi, Amirkabir Univ. of Technology (Iran, Islamic Republic of) ..... [9526-26]

**A novel autocollimating method for measuring the focal distances**, Alexandr G. Ershov, S.I. Vavilov State Optical Institute (Russian Federation) . . . [9526-48]

**Modelling of microcracks image treated with fluorescent dye**, Victor Glebov, Oleg U. Lashmanov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-49]

**High-angle light scattering to determine the optical fiber core**, Grzegorz Swirniak, Wrocław Univ. of Technology (Poland) ..... [9526-51]

**Research of the use of autoreflection scheme to measure the error of the optical elements in space telescope's relative position**, Kseniia Ezhova, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Fedor V. Molev, OAO Avangard (Russian Federation); Igor A. Konyakhin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-52]

**Modeling and analysis of the solar concentrator in photovoltaic systems**, Janusz Mroczka, Kamil Plachta, Wrocław Univ. of Technology (Poland) [9526-53]

**In situ estimate of duty cycle of surface-relief holographic gratings during development by measuring TM/TE diffraction efficiency ratio**, Biyao Shen, Tsinghua Univ. (China); Lijiang Zeng, Tsinghua Univ (China); Lifeng Li, Tsinghua Univ. (China) ..... [9526-54]

**Investigation of a mathematical model of the system of electro-optical sensors for monitoring nonlinear surfaces**, Andrey V. Petrochenko, Igor A. Konyakhin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-55]

**Using quaternions to control assembly and adjustment mirror-prism optical systems**, Kseniia Ezhova, Victor Zverev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-56]

**Absolute testing of flats in sub-stitching interferometer by rotation-shift method**, Xin Jia, Fuchao Xu, Tingwen Xing, Institute of Optics and Electronics (China) ..... [9526-57]

**Scanning in the optical vortex microscope**, Agnieszka Popiołek-Masajada, Lukasz Piócienniczak, Jan Masajada, Sławomir Drobczynski, Mateusz M. Szatkowski, Wrocław Univ. of Technology (Poland) ..... [9526-58]

**Maximum power point search method for photovoltaic panels which uses a light sensor in the conditions of real shading and temperature**, Janusz Mroczka, Mariusz Ostrowski, Wrocław Univ. of Technology (Poland) .. [9526-59]

**The study of the structural stability of the spiral laser beams propagation through inhomogeneous phase medium**, Alexander A. Zinchik, Yana B Muzychenko, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9526-60]

**Simulation and analysis of lightweight space mirror design**, Polina A. Abdula, Mikhail Y. Neutov, Nadezhda D. Tolstoba, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) [9526-62]

**Propagation invariant laser beams for optical metrology applications**, Michael G. Soskind, Rutgers, The State Univ. of New Jersey (United States); Yakov G. Soskind, DHPG Technologies (United States) ..... [9526-63]

**A Bohmian analysis of Afshar's experiment**, Juan David Navia, John H. Reina, Univ. del Valle (Colombia); Detlef Dürr, Ludwig-Maximilians-Univ. München (Germany) ..... [9526-64]

## WEDNESDAY 24 JUNE

### SESSION 5

LOCATION: ROOM 3 ..... WED 8:30 TO 10:00

#### Stochastic Scattering and Nanoparticles

Session Chair: **Egbert Buhr**,  
Physikalisch-Technische Bundesanstalt (Germany)

8:30: **Simulating the coherent light propagation in a random scattering materials using the perturbation expansion (Invited Paper)**, Maciej Kraszewski, Michał Trojanowski, Marcin R. Strakowski, Jerzy Plucinski, Gdansk Univ. of Technology (Poland) ..... [9526-20]

9:00: **The optical properties of tropospheric soot aggregates determined with the DDA (Discrete Dipole Approximation) method**, Krzysztof Skorupski, Wrocław Univ. of Technology (Poland) ..... [9526-21]

9:20: **Detection of fast flying nanoparticles by light scattering over a large volume**, Federico Pettazzi, Stefan M. Bäumer, Jacques C. J. van der Donck, Alex Deutz, TNO (Netherlands) ..... [9526-23]

9:40: **Nonspherical nanoparticles characterization by partially depolarized dynamic light scattering**, Alexander Levin, Ekaterina Shmitkova, All-Russian Research Institute for Optical and Physical Measurement (Russian Federation) ..... [9526-22]

Coffee Break ..... Wed 10:00 to 10:30

### PLENARY SESSION

LOCATION: SAAL 1 ..... WED 10:30 TO 11:25

#### Extreme Computational Imaging: Photography, Health-tech and Displays

Ramesh Raskar, MIT Media Lab., United States

### SESSION 6

LOCATION: ROOM 3 ..... WED 11:30 TO 12:20

#### Optical Material Parameters and Thin Films

Session Chair: **Michael Schulz**,  
Physikalisch-Technische Bundesanstalt (Germany)

11:30: **Nondestructive measurement of two-dimensional refractive index profiles by deflectometry (Invited Paper)**, Di Lin, James R. Leger, Univ. of Minnesota, Twin Cities (United States) ..... [9526-24]

12:00: **Problems in thin film thickness measurement resolved: improvements of the fast Fourier transform analysis and consideration of the numerical aperture of microscope headers and collimators**, Michael Quinten, Faiza Houta, Thomas Fries, FRT, Fries Research & Technology GmbH (Germany) ..... [9526-25]

Lunch Break ..... Wed 12:20 to 14:00

# CONFERENCE 9526

LOCATION: ROOM SAAL 1

## SESSION 7

LOCATION: ROOM 3 ..... WED 14:00 TO 15:30

### Scatterometry II

Session Chair: **Richard Quintanilha**, National Institute of Standards and Technology (United States)

14:00: **Methods for optical modeling and cross-checking in ellipsometry and scatterometry** (*Invited Paper*), Peter Petrik, Research Institute for Technical Physics and Materials Science (Hungary) and Univ. of Pannonia (Hungary) and Technische Univ. Delft (Netherlands); Balint Fodor, Research Institute for Technical Physics and Materials Science (Hungary) and Univ. of Pécs (Hungary); Emil Agocs, Research Institute for Technical Physics and Materials Science (Hungary) and Physikalisch-Technische Bundesanstalt (Germany); Peter Kozma, Judit Nador, Research Institute for Technical Physics and Materials Science (Hungary); Nitish Kumar, Technische Univ. Delft (Netherlands); Johannes Endres, Physikalisch-Technische Bundesanstalt (Germany); Gyorgy Juhasz, Csaba Major, Research Institute for Technical Physics and Materials Science (Hungary); Silvania F. Pereira, Technische Univ. Delft (Netherlands); T. Lohner, Research Institute for Technical Physics and Materials Science (Hungary); H. Paul Urbach, Technische Univ. Delft (Netherlands); Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany); Miklos Fried, Research Institute for Technical Physics and Materials Science (Hungary) ..... [9526-27]

14:30: **Validation of advanced 3D modelling and data analysis for scatterometry**, Sven Burger, Lin Zschiedrich, JCMwave GmbH (Germany); Frank Schmidt, Martin Weiser, Zuse Institute Berlin (Germany); Bernd Bodermann, Matthias Wurm, Victor Soltwisch, Physikalisch-Technische Bundesanstalt (Germany) ..... [9526-28]

14:50: **The statistical inverse problem of scatterometry: Bayesian inference and the effect of different priors**, Sebastian Heidenreich, Hermann A. Gross, Matthias Wurm, Bernd Bodermann, Markus Bär, Physikalisch-Technische Bundesanstalt (Germany) ..... [9526-29]

15:10: **The effect of systematic errors on the hybridization of optical critical dimension measurements**, Mark-Alexander Henn, Bryan M Barnes, Nien-Fan Zhang, Hui Zhou, Richard M Silver, National Institute of Standards and Technology (United States) ..... [9526-30]

## SESSION 8

LOCATION: ROOM 3 ..... WED 16:00 TO 17:20

### Microscopy and Imaging

Session Chair: **Karsten Frenner**, Institut für Technische Optik (Germany)

16:00: **Simulation of light in-coupling through an aperture probe to investigate light propagation in a thin layer for opto-electronic application**, Markus Ermes, Stephan Lehnen, Zhao Cao, Karsten Bittkau, Reinhard Carius, Forschungszentrum Jülich GmbH (Germany) ..... [9526-33]

16:20: **Effect of wavefront aberrations on a focused plenoptic imaging system: a wave optics simulation approach**, Massimo Turola, City Univ. London (United Kingdom); Chris J. Meah, Richard J. Marshall, Iain B. Styles, The Univ. of Birmingham (United Kingdom); Stephen Gruppetta, City Univ. London (United Kingdom) ..... [9526-34]

16:40: **Total variation iterative constraint algorithm for limited-angle tomographic reconstruction of non-piecewise-constant structures**, Wojciech Krauze, Piotr L. Makowski, Malgorzata Kujawinska, Warsaw Univ. of Technology (Poland) ..... [9526-35]

17:00: **A cascaded plasmonic superlens for near field imaging with magnification**, Liwei Fu, Univ. Stuttgart (Germany); Philipp Schau, Karsten Frenner, Wolfgang Osten, Institut für Technische Optik (Germany) ..... [9526-36]

## THURSDAY 25 JUNE

## SESSION 9

LOCATION: ROOM 3 ..... THU 8:10 TO 10:00

### Interferometry and Phase II

Session Chair: **Wolfgang Osten**, Institut für Technische Optik (Germany)

8:10: **Calibration of the amplification coefficient in interference microscopy by means of a wavelength standard** (*Invited Paper*), Peter J. de Groot, Jake L. Beverage, Zygo Corporation (United States) ..... [9526-37]

8:40: **In-line digital holography with double knife edge**, Claudio N. Ramirez, Univ. Autónoma de Barcelona (Spain); Claudio C. Lemmi, Univ. de Buenos Aires (Argentina); Juan Campos, Univ. Autónoma de Barcelona (Spain) ..... [9526-38]

9:00: **Fourier analysis of quadratic phase interferograms**, Jesús Muñoz-Maciel, Miguel Mora-González, Francisco J. Casillas-Rodríguez, Francisco G. Peña-Lecona, Univ. de Guadalajara (Mexico) ..... [9526-39]

9:20: **Phase retrieval based on diffraction element array with single far field**, Shuai Wang, Ping Yang, Lizhi Dong, Bing Xu, Institute of Optics and Electronics (China); Mingwu Ao, Univ. of Electronic Science and Technology of China (China) ..... [9526-40]

9:40: **Dynamic stitching interferometric testing for large optical plane**, Xin Wu, Shanghai Univ (China) and Univ. of Huddersfield (United Kingdom); Te Qi, Shanghai Univ (China); Linna Zhang, Zhengzhou University (China); Yingjie Yu, Shanghai Univ (China) ..... [9526-41]

Coffee Break ..... Thu 10:00 to 10:30

## SESSION 10

LOCATION: ROOM 3 ..... THU 10:30 TO 12:40

### Mueller Polarimetry

Session Chair: **Peter Petrik**, Research Institute for Technical Physics and Materials Science (Hungary)

10:30: **Mueller matrix scatterometry: revisited from the viewpoint of computational metrology** (*Invited Paper*), Shiyuan Liu, Xiuguo Chen, Chuanwei Zhang, Hao Jiang, Huazhong Univ. of Science and Technology (China) ..... [9526-42]

11:00: **Snapshot polarimeter based on the conical refraction phenomenon**, Alba Peinado, Angel Lizana, Alejandro Turpin, Irene Estévez, Univ. Autónoma de Barcelona (Spain); Claudio C. Lemmi, Univ. de Buenos Aires (Argentina); Todor K. Kalkandjiev, Jordi Mompert, Juan Campos, Univ. Autónoma de Barcelona (Spain) ..... [9526-46]

11:20: **Measurement errors induced by axis tilt of biplates in dual-rotating compensator Mueller matrix ellipsometers**, Honggang Gu, Chuanwei Zhang, Hao Jiang, Xiuguo Chen, Weiqi Li, Shiyuan Liu, Huazhong Univ. of Science and Technology (China) ..... [9526-43]

11:40: **Development of Mueller matrix imaging scatterometry for nanostructure metrology**, Xiuguo Chen, Weichao Du, Chuanwei Zhang, Hao Jiang, Shiyuan Liu, Huazhong Univ. of Science and Technology (China) [9526-44]

12:00: **Correction of depolarization effect in Mueller matrix ellipsometry with polar decomposition method**, Weiqi Li, Chuanwei Zhang, Hao Jiang, Xiuguo Chen, Honggang Gu, Shiyuan Liu, Huazhong Univ. of Science and Technology (China) ..... [9526-45]

12:20: **Parallel aligned liquid crystal on silicon display based optical set-up for the generation of polarization spatial distributions**, Irene Estévez, Angel Lizana, Xuejie Zheng, Alba Peinado, Claudio N. Ramirez, Univ. Autónoma de Barcelona (Spain); José Luis Martínez, Univ. Miguel Hernández de Elche (Spain); Andrés Márquez, Univ. de Alicante (Spain); Ignacio Moreno, Univ. Miguel Hernández de Elche (Spain); Juan Campos, Univ. Autónoma de Barcelona (Spain) ..... [9526-47]

## CLOSING REMARKS

LOCATION: ROOM 3 ..... 12:40 TO 12:50

Session Chair: **Bernd Bodermann**, Physikalisch-Technische Bundesanstalt (Germany)

# CONFERENCE 9527

LOCATION: ROOM 12A

Wednesday–Thursday 24–25 June 2015 • Proceedings of SPIE Vol. 9527

## Optics for Arts, Architecture, and Archaeology V

Conference Chairs: **Luca Pezzati**, Istituto Nazionale di Ottica (Italy); **Piotr Targowski**, Nicolaus Copernicus Univ. (Poland)

Programme Committee: **Dario Ambrosini**, Univ. degli Studi dell'Aquila (Italy); **John F. Asmus**, Univ. of California, San Diego (United States); **Brunetto Giovanni Brunetti**, Univ. degli Studi di Perugia (Italy); **Marta Castillejo**, Consejo Superior de Investigaciones Científicas (Spain); **Alberto de Tagle**, Netherlands Institute for Cultural Heritage (Netherlands); **John K. Delaney**, National Gallery of Art (United States); **Raffaella E. M. Fontana**, Istituto Nazionale di Ottica (Italy); **Roger Groves**, Technische Univ. Delft (Netherlands); **Igor P. Gurov**, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); **Alexander J. Kossolapov**, State Hermitage Museum (Russian Federation); **Haida Liang**, Nottingham Trent Univ. (United Kingdom); **Nicola Masini**, Consiglio Nazionale delle Ricerche (Italy); **David R. Saunders**, The British Museum (United Kingdom); **Robert Sitnik**, Warsaw Univ. of Technology (Poland); **Heike Stege**, Doerner Institut (Germany); **Vivi Tornari**, Foundation for Research and Technology–Hellas (Greece)

### WEDNESDAY 24 JUNE

#### SESSION 1

LOCATION: ROOM 12A ..... WED 8:50 TO 10:00

#### New Methods and Applications for Restoration

Session Chair: **Bruno G Brunetti**, Univ. degli Studi di Perugia (Italy)

8:50: **Ultraviolet and infrared laser removal of crustose lichens from heritage dolostone** (*Invited Paper*), Marta Castillejo, Mikel Sanz, Mohamed Oujja, Carmen Ascaso, Asunción de los Ríos, Sergio Pérez-Ortega, Virginia Souza-Egipsy, Jacek Wierzbos, Mariela Speranza, Consejo Superior de Investigaciones Científicas (Spain) ..... [9527-1]

9:20: **High-selectivity cleaning of historical paper samples with sizing through femtosecond laser ablation**, Tansu Ersoy, Cetin Yaman, Istanbul Technical Univ. (Turkey); Mehmet Uguryol, Yildiz Technical Univ. (Turkey); Gurcan Mavili, Mimar Sinan Fine Arts University (Turkey); Selcuk Akturk, Istanbul Technical Univ. (Turkey) ..... [9527-2]

9:40: **Evaluation of surface laser cleaning for restoration of tarnished silver artefacts**, Teresa Palomar, Ctr. Nacional de Investigaciones Metalúrgicas (Spain); Mohamed Oujja, Consejo Superior de Investigaciones Científicas (Spain); Blanca Ramirez-Barat, Emilio Cano, Ctr. Nacional de Investigaciones Metalúrgicas (Spain); Marta Castillejo, Consejo Superior de Investigaciones Científicas (Spain) ..... [9527-3]

Coffee Break ..... Wed 10:00 to 10:30

#### PLENARY SESSION

LOCATION: SAAL 1 ..... WED 10:30 TO 11:25

#### Extreme Computational Imaging: Photography, Health-tech and Displays

**Ramesh Raskar**, MIT Media Lab., United States

#### POSTERS—WEDNESDAY

LOCATION: ICM FOYER ..... WED 11:30 TO 12:30

Conference attendees are invited to attend the Optics for Arts, Architecture, and Archaeology (O3A) Poster Session on Wednesday morning. Authors of poster papers scheduled for presentation in the O3A Conference will be present to answer questions concerning their papers.

Conference attendees are also invited to attend the general Optical Metrology Poster Session on Tuesday afternoon. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 10:00 hrs on Tuesday through 12:00 hrs on Thursday.

Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**Microtopographic characterization of pre-colonial Brazilian archaeological ceramics**, Manuel Filipe P. C. M. Martins Costa, Univ. do Minho (Portugal); Wagner V. Magalhães, Márcia A. Alves, Univ. de São Paulo (Brazil) ... [9527-29]

**Thermal imaging method to visualize a hidden painting thermally excited by far-infrared radiations**, Tanguy Davin, Xingkai Wang, Abderrahim Chabane, Romain Pawelko, Géraldine Guida, Bruno Serio, Philippe Hervé, Univ. Paris Ouest Nanterre La Défense (France) ..... [9527-30]

**'Cranach inc.' A case study determining the nature and extent of Lucas Cranach the Elder's involvement in his industrious workshop using image processing**, Ruth Lubashevsky, Ben Gurion Univ. of the Negev (Israel) [9527-31]

**Quality assessment of the TLS data in conservation of monuments**, Jakub S. Markiewicz, Dorota Zawieska, Warsaw Univ. of Technology (Poland) ..... [9527-33]

**The influence of environment on corrosion of cast iron and carbon steel representing samples of outdoor metal technical heritage**, Marek Strzelec, Jan A. Marczak, Wojciech Skrzeczanowski, Military Univ. of Technology (Poland); Anna Zatorska, Academy of Fine Arts, Warsaw (Poland); Antoni Sarzyński, Krzysztof Czyż, Military Univ. of Technology (Poland); Dariusz Zasada, Military Univ of Technology (Poland) ..... [9527-34]

**Painting recognition with smartphones equipped with inertial measurement unit**, Andrea Masiero, Alberto Guarnieri, Francesco Pirotti, Antonio Vettore, Univ. degli Studi di Padova (Italy) ..... [9527-35]

**Characterization of multispectral imaging systems on frescoes: CMOS versus scanning devices**, Raffaella E. M. Fontana, Istituto Nazionale di Ottica (Italy); Jana Striova, European Lab. for Non-linear Spectroscopy (Italy); Marco Barucci, Enrico M. Pampaloni, Istituto Nazionale di Ottica (Italy); M. Raffaelli, Istituto Nazionale di Ottica, INO-CNR (Italy); Claudia Daffara, Carlo Reghelin, Univ. degli Studi di Verona (Italy); Paola Illaria Mariotti, Opificio delle Pietre Dure (Italy) ..... [9527-36]

Lunch Break ..... Wed 12:30 to 13:50



# CONFERENCE 9527

LOCATION: ROOM 12A

## SESSION 2

LOCATION: ROOM 12A ..... WED 13:50 TO 15:20

### Stratigraphics and Depth-resolved Methods

Session Chair: **Claudia Daffara**, Univ. degli Studi di Verona (Italy)

13:50: **High resolution Fourier domain optical coherence tomography at 2 microns for high depth of penetration** (*Invited Paper*), Haida Liang, Chi Shing Cheung, Nottingham Trent Univ. (United Kingdom); Jae M. O. Daniel, Univ. of Southampton (United Kingdom) and Aether Photonics (Australia); Masaki Tokurakawa, Univ. of Southampton (United Kingdom) and The Univ. of Electro-Communications (Japan); W. Andrew Clarkson, Univ. of Southampton (United Kingdom); Marika Spring, The National Gallery (United Kingdom) [9527-5]

14:20: **Surface reconstruction from photometric normals with reference height measurements**, Lindsay W. MacDonald, Univ. College London (United Kingdom) ..... [9527-6]

14:40: **Combined use of OCT and macro-XRF for examination of easel paintings**, Magdalena A. Iwanicka, Bogumila J. Roubka, Justyna Olszewska-Swietlik, Marcin Sylwestrzak, Piotr Targowski, Nicolaus Copernicus Univ. (Poland) ..... [9527-7]

15:00: **Signal processing and optimization of optical coherence tomography measurements of wood coatings**, Liesbeth M. Dingemans, Vassilis M. Papadakis, Ping Liu, Aurèle J. L. Adam, Roger M. Groves, Technische Univ. Delft (Netherlands) ..... [9527-8]

Coffee Break ..... Wed 15:20 to 16:00

## SESSION 3

LOCATION: ROOM 12A ..... WED 16:00 TO 17:50

### 3D Imaging, Scanning, Topography and Tomography

Session Chair: **Marta Castillejo**, Consejo Superior de Investigaciones Científicas (Spain)

16:00: **Cultural heritage applications of ultrafast pump-probe microscopy** (*Invited Paper*), Tana E. Villafaña, Martin C. Fischer, Duke Univ. (United States); William P. Brown, North Carolina Museum of Art (United States); John K. Delaney, Michael Palmer, National Gallery of Art (United States); Warren S. Warren, Duke Univ. (United States) ..... [9527-25]

16:30: **Resolution limits in holographic display with LED illumination**, Maksymilian Chlipala, Tomasz Kozacki, Warsaw Univ. of Technology (Poland) ..... [9527-11]

16:50: **Light calibration and quality assessment methods for Reflectance Transformation Imaging applied to artworks analysis**, Andrea Giachetti, Claudia Daffara, Carlo Reghelin, Univ. degli Studi di Verona (Italy); Enrico Gobetti, Ruggero Pintus, CRS4 (Italy) ..... [9527-12]

17:10: **Test monitoring of the Centennial Hall's dome, Wroclaw (Poland)**, Lukasz Jan Bednarz, Jerzy Jasienko, Tomasz Nowak, Wroclaw Univ. of Technology (Poland) ..... [9527-13]

17:30: **3D Wayang Kulit: traditional shadow puppetry meets modern display technology**, Gea O. Parikesit, Univ. Gadjah Mada (Indonesia) ..... [9527-14]

## THURSDAY 25 JUNE

## SESSION 4

LOCATION: ROOM 12A ..... THU 8:30 TO 10:00

### Image Processing and Other Digital Data Processing Methods for Optics

Session Chair: **Roger M. Groves**, Technische Univ. Delft (Netherlands)

8:30: **Design, construction and performance of a high-resolution near-infrared (1000-2500 nm) hyperspectral camera for paintings and works on paper** (*Invited Paper*), John K. Delaney, National Gallery of Art (United States); Damon M. Conover, The George Washington Univ. (United States); Kathryn Dooley, National Gallery of Art (United States) and The George Washington Univ. (United States); Suzanne Lomax, National Gallery of Art (United States); Murray H. Loew, The George Washington Univ. (United States) ..... [9527-15]

9:00: **Automated analysis of large scale remote spectral imaging of paintings**, Sotiria Kogou, Golnaz Shahtahmasebi, Andrei Lucian, Chi Shing Cheung, Nottingham Trent Univ. (United Kingdom); Bomin Su, Dunhuang Academy (China); Haida Liang, Nottingham Trent Univ. (United Kingdom) ..... [9527-16]

9:20: **The role of the masonry in paintings during a seismic event analyzed by infrared vision**, Fernando López, Univ. Federal de Santa Catarina (Brazil); Stefano Sfarra, Univ. degli Studi dell'Aquila (Italy); Clemente Ibarra-Castanedo, Univ. Laval (Canada); Dario Ambrosini, Univ. degli Studi dell'Aquila (Italy); Xavier P. V. Maldague, Univ. Laval (Canada) ..... [9527-17]

9:40: **Semi-automatic system for UV images analysis of historical musical instruments**, Piercarlo Dondi, Claudia Invernizzi, Maurizio Licchelli, Luca Lombardi, Marco Malagodi, Tommaso Rovetta, Univ. degli Studi di Pavia (Italy) ..... [9527-18]

Coffee Break ..... Thu 10:00 to 10:30

## SESSION 5

LOCATION: ROOM 12A ..... THU 10:30 TO 12:40

### Integrated Techniques and Case Studies

Session Chair: **Vivi Tornari**, Foundation for Research and Technology-Hellas (Greece)

10:30: **Mid-infrared thermal imaging for an effective mapping of surface materials and sub-surface detachments in mural paintings: integration of thermography and thermal quasi-reflectography** (*Invited Paper*), Claudia Daffara, Univ. degli Studi di Verona (Italy); Simone Parisotto, Univ. of Cambridge (United Kingdom); Paola Ilaria Mariotti, Opificio delle Pietre Dure (Italy) [9527-19]

11:00: **Optical characteristics and visual appearance for artwork materials**, Michela Radis, Paola Iacomussi, Istituto Nazionale di Ricerca Metrologica (Italy); Chiara Aghemo, Politecnico di Torino (Italy) ..... [9527-20]

11:20: **Terahertz and multispectral imaging of a Tanda painting**, J. Bianca Jackson, The Univ. of Reading (United Kingdom); Marcello Melis, ProfiloColore Srl (Italy); Gillian C. Walker, The Univ. of Reading (United Kingdom); David Giovannacci, Dominique Martos-Leviv, Lab. de Recherche des Monuments Historiques (France); John W. Bowen, Lab. de Recherche des Monuments Historiques (France) and The Univ. of Reading (United Kingdom); Matteo Miccoli, ProfiloColore Srl (Italy); Vincent Detalle, Lab. de Recherche des Monuments Historiques (France) ..... [9527-21]

11:40: **Case study of Sainte-Marie Chapel, Fontaine Chaalis (France): complementarity of different optical techniques**, David Giovannacci, Vincent Detalle, Dominique Martos-Leviv, Lab. de Recherche des Monuments Historiques (France); Eirini Bernikola, Vivi Tornari, Kostas Hatzigiannakis, Foundation for Research and Technology-Hellas (Greece); Kamel Mouhoubi, Jean-Luc Bodnar, Univ. de Reims Champagne-Ardenne (France); Gillian C. Walker, John W. Bowen, The Univ. of Reading (United Kingdom); Bianca M. Jackson, School of Systems Engineering University of Readings (United Kingdom) ..... [9527-22]

12:00: **Photogrammetry in maritime and underwater archaeology: two marble wrecks from Sicily**, Caterina Balletti, Francesco Guerra, Paolo Vernier, Univ. Iuav di Venezia (Italy); Carlo Beltrame, Univ. Ca' Foscari di Venezia (Italy); Elisa Costa, Univ. Iuav di Venezia (Italy) ..... [9527-23]

12:20: **Spectral characterization as a tool for parchment analysis**, Michela Radis, Paola Iacomussi, Giuseppe Rossi, Istituto Nazionale di Ricerca Metrologica (Italy) ..... [9527-24]

Lunch Break ..... Thu 12:40 to 14:00

## SESSION 6

LOCATION: ROOM 12A ..... THU 14:00 TO 15:30

### Imaging and Multimodal Imaging

Session Chair: **Haida Liang**, Nottingham Trent Univ. (United Kingdom)

14:00: **Multiscale study of parchments and their degradation using nonlinear microscopy and AFM-IR** (*Invited Paper*), Gaël Latour, Univ. Paris-Sud 11 (France); Laurianne Robinet, Muséum national d'Histoire naturelle (France); Ariane Deniset-Besseau, Alexandre Dazzi, Univ. Paris-Sud 11 (France); Marie-Claire Schanne-Klein, Lab. d'Optique et Biosciences (France) ... [9527-9]

14:30: **Hyperspectral remote sensing techniques applied to the noninvasive investigation of mural paintings: a feasibility study carried out on a wall painting by Beato Angelico in Florence**, Costanza Cucci, Marcello Picollo, Istituto di Fisica Applicata Nello Carrara (Italy); Leandro Chiarantini, Barbara Sereni, SELEX ES S.p.A. (Italy) ..... [9527-26]

14:50: **Combination of topology and structural information for damages and deterioration analysis of artworks**, Dominic Buchta, Univ. Stuttgart (Germany); Niclas Hein, Staatliche Akademie der Bildenden Künste Stuttgart (Germany); Giancarlo Pedrini, Univ. of Stuttgart (Germany); Christoph Krekel, Staatliche Akademie der Bildenden Künste Stuttgart (Germany); Wolfgang Osten, Univ. Stuttgart (Germany) ..... [9527-27]

15:10: **Measuring environmental impact by real time laser differential displacement technique in simulated climate conditions**, Eirini Bernikola, Vivi Tornari, Foundation for Research and Technology-Hellas (Greece); Nota Tsigarida, Ctr. for Research and Technology Hellas (Greece); Kostas Hatzigiannakis, Foundation for Research and Technology-Hellas (Greece); Michalis Andrianakis, Ctr. for Research and Technology Hellas (Greece); Johanna Leissner, Fraunhofer ISC (Germany) ..... [9527-28]



# CONFERENCE 9528

LOCATION: ROOM 12A

Monday–Tuesday 22–23 June 2015 • Proceedings of SPIE Vol. 9528

## Videometrics, Range Imaging, and Applications XIII

Conference Chairs: **Fabio Remondino**, Fondazione Bruno Kessler (Italy); **Mark R. Shortis**, RMIT Univ. (Australia)

Programme Committee: **Jean-Angelo Beraldin**, National Research Council Canada (Canada); **Jan Boehm**, Univ. College London (United Kingdom); **Werner Boesemann**, AlCON 3D Systems GmbH (Germany); **Simon Buckley**, Ctr. for Integrated Petroleum Research (Norway); **Takashi Fuse**, The Univ. of Tokyo (Japan); **Gabriele Guidi**, Politecnico di Milano (Italy); **Derek D. Lichti**, Univ. of Calgary (Canada); **Thomas Luhmann**, Jade Hochschule (Germany); **Hans-Gerd Maas**, Technische Univ. Dresden (Germany); **Jon P. Mills**, Newcastle Univ. (United Kingdom); **Norbert Pfeifer**, Technische Univ. Wien (Austria); **Stuart Robson**, Univ. College London (United Kingdom); **David Stoppa**, Fondazione Bruno Kessler (Italy)

### MONDAY 22 JUNE

#### SESSION 1

LOCATION: ROOM 12A ..... MON 11:10 TO 13:10

#### Light Field Videometry: Point Cloud Analysis

Session Chair: **Fabio Remondino**, Fondazione Bruno Kessler (Italy)

11:10: **Light field-based videometry** (*Invited Paper*), Bernd Jähne, Ruprecht-Karls-Univ. Heidelberg (Germany) ..... [9528-1]

11:50: **Light-field camera design for high-accuracy depth estimation**, Maximilian Diebold, Oliver Blum, Marcel Gutsche, Heidelberg Collaboratory for Image Processing (Germany); Sven Wanner, HCI (Germany); Christoph S. Garbe, Harlyn Baker, Bernd Jähne, Heidelberg Collaboratory for Image Processing (Germany) ..... [9528-2]

12:10: **Knowledge guided object detection and identification in 3D point clouds**, Ashish Karmacharya, Frank Boochs, Burkhard Tietz, i3mainz (Germany) and Hochschule Mainz (Germany) ..... [9528-4]

12:30: **The analysis of selected orientation methods of architectural objects' scans**, Jakub S. Markiewicz, Irmina Kajdewicz, Dorota Zawieska, Warsaw Univ. of Technology (Poland) ..... [9528-5]

12:50: **Improving depth estimation from a plenoptic camera by patterned illumination**, Richard J. Marshall, Chris J. Meah, The Univ. of Birmingham (United Kingdom); Massimo Turola, City Univ. London (United Kingdom); Ela Claridge, Alex P. G. Robinson, Kai Bongs, The Univ. of Birmingham (United Kingdom); Stephen Gruppetta, City Univ. London (United Kingdom); Iain B. Styles, The Univ. of Birmingham (United Kingdom) ..... [9528-42]

Lunch Break ..... Mon 13:10 to 14:20

#### SESSION 2

LOCATION: ROOM 12A ..... MON 14:20 TO 16:00

#### Structured Light and Fringe Analysis

Session Chair: **Takashi Fuse**, The Univ. of Tokyo (Japan)

14:20: **3D measurement with active triangulation for spectacle lens optimization and individualization**, Julia Gehrmann, Hochschule für Angewandte Wissenschaften München (Germany); Markus Tiemann, Peter C. Seitz, Rodenstock GmbH (Germany) ..... [9528-10]

14:40: **Detection of defects in a transparent polymer with high resolution tomography using white light scanning interferometry and noise reduction**, Audrey Leong-Hoi, Rémy Claveau, Manuel Flury, Wilfried Uhring, Univ. de Strasbourg (France); Bruno Serio, Univ. Paris Ouest Nanterre La Défense (France); Freddy Anstötz, Univ. de Strasbourg (France); Paul C. Montgomery, Univ. de Strasbourg (France) ..... [9528-11]

15:00: **3D reconstruction with single image pairs and structured light projection for short-term ultra-high-speed applications**, Christian Bräuer-Burchardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Stefan Heist, Patrick Dietrich, Fraunhofer IOF (Germany); Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) ..... [9528-12]

15:20: **Handheld underwater 3D sensor based on fringe projection technique**, Christian Bräuer-Burchardt, Matthias Heinze, Ingo Schmidt, Lichun Meng, Roland Ramm, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) ..... [9528-13]

15:40: **Profilometry of discontinuous solids by means of co-phased demodulation of projected fringes with RGB encoding**, Jose Moises Padilla, Manuel Servin, Guillermo Garnica, Ctr. de Investigaciones en Óptica, A.C. (Mexico) ..... [9528-14]

Coffee Break ..... Mon 16:00 to 16:30

#### SESSION 3

LOCATION: ROOM 12A ..... MON 16:30 TO 17:50

#### Calibration and Accuracy

Session Chair: **Mark R. Shortis**, RMIT Univ. (Australia)

16:30: **Development of orientation method with constraint conditions using vector data**, Takashi Fuse, Keita Kamiya, The Univ. of Tokyo (Japan) .. [9528-6]

16:50: **Development, comparison, and evaluation of software for radial distortion elimination**, Alexandra I. Papadaki, Andreas Georgopoulos, National Technical Univ. of Athens (Greece) ..... [9528-7]

17:10: **Relevance of ellipse eccentricity for camera calibration**, Waldemar Mordwinzew, Burkhard Tietz, Frank Boochs, i3mainz (Germany); Dietrich Paulus, Institute for Computational Visualistics, Universität Koblenz (Germany) .. [9528-8]

17:30: **Self-calibration of a structured light based scanner for use in archeological applications**, Adam V. Jahraus, Derek D. Lichti, Peter Dawson, Univ. of Calgary (Canada) ..... [9528-9]

### TUESDAY 23 JUNE

#### SESSION 4

LOCATION: ROOM 12A ..... TUE 8:30 TO 10:10

#### Metrology Applications

Session Chair: **Mark R. Shortis**, RMIT Univ. (Australia)

8:30: **Optical metrology with low-cost camera systems for advanced manufacturing** (*Invited Paper*), Stuart Robson, Univ. College London (United Kingdom) ..... [9528-15]

9:10: **Assessment of the accuracy of 3D models obtained with DSLR camera and Kinect v2**, Elise Lachat, Hélène Macher, Tania Landes, Pierre Grussenmeyer, Institut National des Sciences Appliquées de Strasbourg (France) ..... [9528-16]

9:30: **Improving automated 3D reconstruction methods via vision metrology**, Isabella Toschi, Erica Nocerino, Fondazione Bruno Kessler (Italy); Mona Hess, Univ. College London (United Kingdom); Fabio Menna, Fondazione Bruno Kessler (Italy); Ben Sargeant, Lindsay W. MacDonald, Univ. College London (United Kingdom); Fabio Remondino, Fondazione Bruno Kessler (Italy); Stuart Robson, Univ. College London (United Kingdom) ..... [9528-17]

9:50: **Determining the coordinates of lamps in an illumination dome**, Lindsay W. MacDonald, Univ. College London (United Kingdom); Ali H. Ahmadabadian, Univ. of Tehran (Iran, Islamic Republic of); Stuart Robson, Univ. College London (United Kingdom) ..... [9528-18]

Coffee Break ..... Tue 10:10 to 10:30

# CONFERENCE 9528

LOCATION: ROOM 12A

## SESSION 5

LOCATION: ROOM 12A ..... TUE 10:30 TO 12:30

### Image Sequences and Tracking: UAV Applications

Session Chair: **Thomas Luhmann**, Jade Hochschule (Germany)

10:30: **Tracking of object deformations in color and depth video: deformation models and applications** (*Invited Paper*), Andreas Jordt, Stefan Reinhold, Reinhard Koch, Christian-Albrechts-University Kiel (Germany) ..... [9528-19]

11:10: **Comparison between single and multi-camera view videogrammetry for estimating 6DOF of a rigid body**, Erica Nocerino, Fabio Menna, Fondazione Bruno Kessler (Italy) ..... [9528-20]

11:30: **Fast instantaneous center of rotation estimation algorithm for a skied-steered robot**, Vladimir V. Kniaz, GosNIIAS (Russian Federation) ..... [9528-21]

11:50: **Investigating influence of UAV flight patterns in multi-stereo view DSM accuracy**, Dimitrios P. Skarlatos, Marinos Vlachos, Cyprus Univ. of Technology (Cyprus); Vasilis Vamvakousis, Cyprus Univ of Technology (Cyprus) ..... [9528-23]

**DISCUSSION** ..... TUE 12:10 to 12:30

Lunch Break ..... Tue 12:30 to 14:10

## SESSION 6

LOCATION: ROOM 12A ..... TUE 14:10 TO 15:30

### Image Matching and Surface Models

Session Chair: **Stuart Robson**, Univ. College London (United Kingdom)

14:10: **Multi-image semi-global matching in object space**, Folkmar Bethmann, Thomas Luhmann, Jade Hochschule (Germany) ..... [9528-24]

14:30: **3D city models completion by fusing lidar and image data**, Lazaros Grammatikopoulos, Ilias Kalisperakis, Elli Petsa, Technological Educational Institute of Athens (Greece); Christos Stentoumis, National Technical Univ. of Athens (Greece) ..... [9528-25]

14:50: **DTM generation from STC-SIMBIO-SYS images**, Cristina Re, INAF - Osservatorio Astronomico di Padova (Italy); Emanuele E. S. Simioni, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Gabriele Cremonese, INAF - Osservatorio Astronomico di Padova (Italy); Riccardo Roncella, Gianfranco Forlani, Univ. degli Studi di Parma (Italy); Vania Da Deppo, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and INAF - Osservatorio Astronomico di Padova (Italy); Giampiero Naletto, Univ. degli Studi di Padova (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy) and INAF - Osservatorio Astronomico di Padova (Italy); Giuseppe Salemi, Department of Cultural Heritage: Archaeology and History of Art, Cinema and Music (Italy) ... [9528-26]

15:10: **Stereo matching based on census transformation of image gradients**, Christos Stentoumis, National Technical Univ. of Athens (Greece); Lazaros Grammatikopoulos, Ilias Kalisperakis, Technological Educational Institute of Athens (Greece); George I. Karras, National Technical Univ. of Athens (Greece); Elli Petsa, Technological Educational Institute of Athens (Greece) ..... [9528-27]

Coffee Break ..... Tue 15:30 to 16:00

## SESSION 7

LOCATION: ROOM 12A ..... TUE 16:00 TO 17:40

### Range Imaging Modelling and Analysis

Session Chair: **Fabio Remondino**, Fondazione Bruno Kessler (Italy)

16:00: **Single-plane versus three-plane methods for relative range error evaluation of medium-range 3D imaging systems**, David K. MacKinnon, Luc Cournoyer, Jean-Angelo Beraldin, National Research Council Canada (Canada) ..... [9528-28]

16:20: **Extracting the MESA SR4000 calibrations**, Sean A. Charleston, Adrian A. Dorrington, Lee Streeter, Michael J. Cree, The Univ. of Waikato (New Zealand) ..... [9528-29]

16:40: **Enhancing swimming pool safety by the use of range-imaging cameras**, Dave Geerardyn, Sven Boulanger, Maarten Kuijk, Vrije Univ. Brussel (Belgium) ..... [9528-31]

17:00: **Evaluating the capability of time-of-flight cameras for accurately imaging a cyclically loaded beam**, Herve D. Lahamy, Derek D. Lichti, Mamdouh El-Badry, Xiaojuan Qi, Ivan Detchev, Jeremy Steward, Mohammad Moravvej, Univ. of Calgary (Canada) ..... [9528-32]

**DISCUSSION** ..... TUE 17:20 to 17:40

## POSTERS—TUESDAY

LOCATION: ICM FOYER ..... TUE 17:30 TO 19:00

Conference attendees are invited to attend the Optical Metrology Poster Session on Tuesday afternoon. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 10:00 hrs on Tuesday through 12:00 hrs on Thursday.

Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**Hand-eye calibration method based on Schur Decomposition**, Jinbo Liu, National Univ. of Defense Technology (China) ..... [9528-33]

**Precise deformation measurement of prestressed concrete beam during a strain test using the combination of intersection photogrammetry and micro-network measurement**, Rudolf Urban, Jaroslav Braun, Martin Stroner, Czech Technical Univ. in Prague (Czech Republic) ..... [9528-34]

**A simple and flexible calibration method of non-overlapping camera rig**, Guan B. Lei, National Univ. of Defense Technology (China); Yang Shang, National University of Defense Technology (China); Qifeng Yu, National Univ. of Defense Technology (China); Zhi hui Lei, National University of Defense Technology (China); Xiaohu Zhang, National Univ. of Defense Technology (China) ..... [9528-35]

**Performance of a 3D scanner based on structured light projection**, Dalia N. Mahmoud, Abdallah M. Khalil, Mohammad A. Younes, Alexandria Univ. (Egypt) ..... [9528-36]

**The phase correlation algorithm for stabilization of capillary blood flow video frames**, Konstantin A. Karimov, Mikhail V. Volkov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9528-37]

**Efficient estimation of orthophoto images using visibility restriction**, Hiroyuki Miura, Aero Asahi Corp. (Japan); Hirofumi Chikatsu, Tokyo Denki Univ. (Japan) ..... [9528-39]

**Action cameras and low-cost aerial vehicles in archaeology**, Martina Ballarin, Caterina Balletti, Francesco Guerra, Univ. Iuav di Venezia (Italy) ..... [9528-40]

**Miniaturized 3D microscope imaging system**, Yung Sung Lan, Chir-Weei Chang, Hsin-Yueh Sung, Yen-Chang Wang, Cheng-Yi Chang, Industrial Technology Research Institute (Taiwan) ..... [9528-41]

**Frequency-spatial cues based sea-surface salient target detection from UAV image**, Xiaoliang Sun, Xiaolin Liu, Qifeng Yu, Yan Liu, National Univ. of Defense Technology (China) ..... [9528-43]

# CONFERENCE 9529

LOCATION: MONDAY-TUESDAY, ROOM 12B, WEDNESDAY, NOVOTEL-ROOM ZEPPELIN

Monday–Wednesday 22–24 June 2015 • Proceedings of SPIE Vol. 9529

## Optical Methods for Inspection, Characterization, and Imaging of Biomaterials II

*Conference Chairs:* **Pietro Ferraro**, Istituto di Cibernetica Eduardo Caianiello (Italy); **Simonetta Grilli**, Istituto Nazionale di Ottica (Italy); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **David Stifter**, Johannes Kepler Univ. Linz (Austria)

*Programme Committee:* **Luigi Ambrosio**, CNR (Italy); **Jonathan M. Cooper**, Univ. of Glasgow (United Kingdom); **Diego di Bernardo**, Telethon Institute of Genetics and Medicine (Italy); **Alberto Diaspro**, Istituto Italiano di Tecnologia (Italy); **Frank Dubois**, Univ. Libre de Bruxelles (Belgium); **Wolfgang A. Ertmer**, Leibniz Univ. Hannover (Germany); **Roger Groves**, Technische Univ. Delft (Netherlands); **Jochen R. Guck**, Technische Univ. Dresden (Germany); **Theo Lasser**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Fernando Mendoza Santoyo**, Ctr. de Investigaciones en Óptica, A.C. (Mexico); **Lisa Miccio**, Istituto Nazionale di Ottica (Italy); **Serge Monneret**, Institut Fresnel (France); **Paolo A. Netti**, Univ. degli Studi di Napoli Federico II (Italy); **Fiorenzo Gabriele Omenetto**, Tufts Univ. (United States); **Pablo D. Ruiz**, Loughborough Univ. (United Kingdom); **David D. Sampson**, The Univ. of Western Australia (Australia); **Natan Tzvi Shaked**, Tel Aviv Univ. (Israel); **Claudia Tortiglione**, Istituto di Cibernetica Eduardo Caianiello (Italy); **Ruikang K. Wang**, Univ. of Washington (United States); **Zeev Zalevsky**, Bar-Ilan Univ. (Israel)

### MONDAY 22 JUNE

#### SESSION 1

LOCATION: ROOM 12B ..... MON 11:10 TO 13:10

#### Quantitative Phase Imaging

Session Chair: **Hugo Thienpont**, Vrije Univ. Brussel (Belgium)

11:10: **Continuous morphology and growth monitoring of different cell types in a single culture using quantitative phase microscopy**, Björn Kemper, Jana Wibbeling, Lena Kastl, Jürgen Schnekenburger, Steffi Ketelhut, Westfälische Wilhelms-Univ. Münster (Germany) ..... [9529-1]

11:30: **Quantitative phase imaging by wide field lensless digital holographic microscope**, Adamou Adinda-Ougba, Ruhr-Univ. Bochum (Germany); Nektarios Koukourakis, Technische Univ. Dresden (Germany); Aissam Essaidi, Ruhr-University Bochum (Germany); Nils C. Gerhardt, Martin R. Hofmann, Ruhr-Univ. Bochum (Germany) ..... [9529-2]

11:50: **Influence of sample preparation and reliability of automated numerical refocusing in stain-free analysis of dissected tissues with quantitative phase digital holographic microscopy**, Björn Kemper, Westfälische Wilhelms-Univ. Münster (Germany); Philipp Lenz, Dominik Bettenworth, Universitätsklinikum Münster (Germany); Philipp Krausewitz, Dirk Domagk, Steffi Ketelhut, Westfälische Wilhelms-Univ. Münster (Germany) ..... [9529-3]

12:10: **Fourier Ptychography: Using computation to address physical optical challenges** (*Keynote Presentation*), Changhui Yang, California Institute of Technology (United States) ..... [9529-4]

12:40: **Spatial light interference microscopy (SLIM) for histopathology applications** (*Invited Paper*), Gabriel Popescu, Univ. of Illinois at Urbana-Champaign (United States) ..... [9529-5]

Lunch Break ..... Mon 13:10 to 14:10

#### SESSION 2

LOCATION: ROOM 12B ..... MON 14:10 TO 16:10

#### Microscopy I

Session Chair: **Demetri Psaltis**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

14:10: **A new twist on light sheet imaging** (*Invited Paper*), Kishan Dholakia, Univ. of St. Andrews (United Kingdom) ..... [9529-10]

14:40: **Optomechanical properties of cancer cells revealed by light-induced deformation and quantitative phase microscopy**, Lena Kastl, Björn Budde, Michael Isbach, Christina E. Rommel, Björn Kemper, Jürgen Schnekenburger, Westfälische Wilhelms-Univ. Münster (Germany) ..... [9529-11]

15:00: **Monitoring cell morphology during necrosis and apoptosis by quantitative phase imaging** (*Invited Paper*), Martina Mugnano, Alejandro Calabuig, Simonetta Grilli, Lisa Miccio, Pietro Ferraro, Consiglio Nazionale delle Ricerche (Italy) ..... [9529-12]

15:30: **Off-axis digital holographic microscopy by updating a regular upright microscope**, Vicente Micó, Carlos Ferreira, Univ. de València (Spain); Zeev Zalevsky, Bar-Ilan Univ. (Israel); Javier García, Univ. de València (Spain) ..... [9529-13]

15:50: **Multi-illumination Gabor holography recorded in a single camera snap-shot for high-resolution phase retrieval in digital in-line holographic microscopy**, Martin Sanz, Jose Angel Picazo-Bueno, Javier Garcia, Vicente Micó, Univ. de València (Spain) ..... [9529-14]

Coffee Break ..... Mon 16:10 to 16:30

#### SESSION 3

LOCATION: ROOM 12B ..... MON 16:30 TO 18:00

#### Microscopy in Flow

Session Chair: **Roger M. Groves**, Technische Univ. Delft (Netherlands)

16:30: **Wavefronts matching: a novel paradigm for three-dimensional holographic particle tracking**, Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Lisa Miccio, Francesco Merola, Istituto di Cibernetica Eduardo Caianiello (Italy); Paolo A. Netti, Istituto Italiano di Tecnologia (Italy); Pietro Ferraro, Istituto di Cibernetica Eduardo Caianiello (Italy) ..... [9529-6]

16:50: **Cells characterization in microfluidic flows by small angle light scattering and 3D holographic technique**, David Dannhauser, Istituto Italiano di Tecnologia (Italy); Pasquale Memmolo, Istituto Nazionale di Ottica (Italy) and Istituto Italiano di Tecnologia (Italy); Domenico Rossi, Istituto Italiano di Tecnologia (Italy); Francesco Merola, Lisa Miccio, Istituto Nazionale di Ottica (Italy); Filippo Causa, Univ. degli Studi di Napoli Federico II (Italy); Pietro Ferraro, Istituto Nazionale di Ottica (Italy); Paolo A. Netti, Univ. degli Studi di Napoli Federico II (Italy) and Istituto Italiano di Tecnologia (Italy) ..... [9529-7]

17:10: **Optical analysis of nanomaterial-cell interactions: flow cytometry and digital holographic microscopy**, Sarah Mues, Jan Antunovic, Rainer Ossig, Björn Kemper, Jürgen Schnekenburger, Westfälische Wilhelms-Univ. Münster (Germany) ..... [9529-8]

17:30: **Single image correlation for blood flow mapping in complex vessel networks** (*Invited Paper*), Giuseppe Chirico, Laura Sironi, Univ. degli Studi di Milano-Bicocca (Italy); Margaux Bouzin, Univ. degli Studi di Milano Bicocca (Italy); Laura D'Alfonso, Maddalena Collini, Univ. degli Studi di Milano-Bicocca (Italy); Nicolo' G Ceffa, Univ. degli Studi di Milano Bicocca (Italy); Cassia Marquezin, Univ. degli Studi di Milano Bicocca (Italy) and bUniversidade Federal de Goiás, Instituto de Física, Goiânia (Brazil) ..... [9529-9]

### TUESDAY 23 JUNE

#### SESSION 4

LOCATION: ROOM 12B ..... TUE 8:50 TO 10:00

#### Quantitative Imaging

Session Chairs: **Giberto Chirico**; **Giberto Chirico**, Univ. degli Studi di Milano-Bicocca (Italy)

8:50: **Digital holographic micro-interferometry of nonradiative transitions in biological specimens**, Andrey V. Belashov, Ioffe Physico-Technical Institute (Russian Federation) and National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Nikolay V. Petrov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Irina V. Semenova, Ioffe Physical-Technical Institute (Russian Federation); Oleg S. Vasyutinskii, Ioffe Physical-Technical Institute (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation) ..... [9529-15]



# CONFERENCE 9529

LOCATION: MONDAY-TUESDAY, ROOM 12B, WEDNESDAY, NOVOTEL-ROOM ZEPPELIN

9:10: **Extended field of view space-time digital holograms for lab-on-a-chip microfluidic imaging**, Vittorio Bianco, Melania Paturzo, Valentina Marchesano, Pietro Ferraro, Istituto Nazionale di Ottica (Italy). . . . . [9529-16]

9:30: **Imaging with multimode fibers (Keynote Presentation)**, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland). . . . . [9529-17]

Coffee Break . . . . . Tue 10:00 to 10:30

## SESSION 5

LOCATION: ROOM 12B . . . . . TUE 10:30 TO 12:40

### Bioinspired Biomimetics and Nanobiomaterials

Session Chair: **Cornelia Denz**, Westfälische Wilhelms-Univ. Münster (Germany)

10:30: **Photonics-enhanced polymer lab-on-chips : from high-tech prototyping platform to applications (Invited Paper)**, Hugo Thienpont, Vrije Univ. Brussel (Belgium) . . . . . [9529-18]

11:00: **Red blood cell three-dimensional morphometry by quantitative phase microscopy**, Francesco Merola, Istituto di Cibernetica Eduardo Caianiello (Italy); Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Carmela Rianna, Department of Chemical, Materials and Industrial Production Engineering, University of Naples (Italy) and Center for Advanced Biomaterials for Health Care@CRIB, Istituto Italiano di Tecnologia (Italy); Pietro Ferraro, Istituto di Cibernetica Eduardo Caianiello (Italy) . . . . . [9529-19]

11:20: **Imaging and characterization of surface relief gratings on azopolymer by digital holographic microscopy**, Alejandro Calabuig, CNR - ISASI Institute of Applied Sciences & Intelligent Systems "E. Caianiello" (Italy); Carmela Rianna, Department of Chemical, Materials and Industrial Production Engineering, University of Naples (Italy) and Center for Advanced Biomaterials for Health Care@CRIB, Istituto Italiano di Tecnologia (Italy) and Interdisciplinary Research Center on Biomaterials, University of Naples Federico II (Italy); Vito Pagliarulo, CNR - ISASI Institute of Applied Sciences & Intelligent Systems "E. Caianiello" (Italy); Maurizio Ventre, Department of Chemical, Materials and Industrial Production Engineering, University of Naples (Italy) and Center for Advanced Biomaterials for Health Care@CRIB, Istituto Italiano di Tecnologia (Italy); Simonetta Grilli, CNR - ISASI Institute of Applied Sciences & Intelligent Systems "E. Caianiello" (Italy); Paolo Antonio Netti, Center for Advanced Biomaterials for Health Care@CRIB, Istituto Italiano di Tecnologia (Italy) and Department of Chemical, Materials and Industrial Production Engineering, University of Naples (Italy) and Interdisciplinary Research Center on Biomaterials, University of Naples Federico II (Italy); Pietro Ferraro, CNR - ISASI Institute of Applied Sciences & Intelligent Systems "E. Caianiello" (Italy) . . . . . [9529-20]

11:40: **Optical characterisation of complex structures, from engineering composites to biomaterials (Invited Paper)**, Roger M. Groves, Technische Univ. Delft (Netherlands) . . . . . [9529-21]

12:10: **Characterization of piezoelectric materials and the biocompatibility ferroelectric lithium niobate (Invited Paper)**, Brian J. Rodriguez, Univ. College Dublin (Ireland). . . . . [9529-22]

Lunch Break . . . . . Tue 12:40 to 13:40

## SESSION 6

LOCATION: ROOM 12B . . . . . TUE 13:40 TO 15:30

### Micro- and Nanomanipulation of Biological Sample

Session Chair: **Kishan Dholakia**, Univ. of St. Andrews (United Kingdom)

13:40: **Three-axis digital holographic microscopy for high-speed volumetric imaging of swimming cells (Invited Paper)**, Roberto Di Leonardo, National Research Council of Italy (CNR) (Italy) and Dipartimento di Fisica, Sapienza Università di Roma (Italy); Silvio Bianchi, Filippo Saglimbeni, Alessia Lepore, Dipartimento di Fisica, Sapienza Università di Roma (Italy) . . . . . [9529-23]

14:10: **Investigation on cytoskeleton dynamics for non-adherent cells under point-like stimuli**, Lisa Miccio, Istituto Nazionale di Ottica (Italy); Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Francesco Merola, Istituto Nazionale di Ottica (Italy); Martina Mugnano, Sabato Fusco, Antonio Paciello, Istituto Italiano di Tecnologia (Italy); Pietro Ferraro, Istituto di Cibernetica Eduardo Caianiello (Italy); Paolo A. Netti, Istituto Italiano di Tecnologia (Italy) . . . . . [9529-24]

14:30: **Photovoltaic tweezers an emergent tool for applications in nano and bio-technology (Invited Paper)**, Mercedes Carrascosa, Angel García-Cabañes, Mariano Jubera, Iris Elvira, Héctor Burgos, José L. Bella, Fernando Agulló-López, Univ. Autónoma de Madrid (Spain); Juan F. Muñoz-Martínez, Univ. Politécnica de Madrid (Spain) and Univ. Autónoma de Madrid (Spain); Angel Alcázar de Velasco, Univ. Politécnica de Madrid (Spain) . . . . . [9529-25]

15:00: **Controlling self-propelled nanobiorobots by optical micromanipulation (Invited Paper)**, Alvaro Barroso Peña, Florian Hörner, Shirin Landwerth, Cornelia Denz, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [9529-26]

Coffee Break . . . . . Tue 15:30 to 16:00

## SESSION 7

LOCATION: ROOM 12B . . . . . TUE 16:00 TO 18:00

### Microscopy II

Session Chair: **Björn Kemper**, Westfälische Wilhelms-Univ. Münster (Germany)

16:00: **3D phase imaging with computational illumination (Invited Paper)**, Laura Waller, Lei Tian, Zachary F. Phillips, Univ. of California, Berkeley (United States); Chenguang Ma, Univ. of California, Berkeley (United States) and Tsinghua Univ. (China); Ziji Liu, Univ. of California, Berkeley (United States) and Univ. of Electronic Science and Technology of China (China) . . . . . [9529-27]

16:30: **Computational imaging with phase-structured illumination: application in scattering (Invited Paper)**, Enrique Tajahuerce, Lluís Martínez-León, University Jaume I (Spain); Yutaka Mori, Wakayama University (Japan); Pere Clemente, Vicent Climent, Jesús Lancis, University Jaume I (Spain) . . . . . [9529-28]

17:00: **Label-free coherent microscopy through blood by digital holography**, Vittorio Bianco, Melania Paturzo, Francesco Merola, Lisa Miccio, Istituto Nazionale di Ottica (Italy); Pasquale Memmolo, Istituto Italiano di Tecnologia (Italy); Oriella Gennari, Pietro Ferraro, Istituto Nazionale di Ottica (Italy) [9529-29]

17:20: **Superresolution imaging system on innovative localization microscopy technique with commonly using dyes and CMOS camera**, Varvara V. Dudenkova, N.I. Lobachevsky State Univ. of Nizhni Novgorod (Russian Federation); Yuri Zakharov, N.I. Lobachevsky State University of Nizhni Novgorod (Russian Federation). . . . . [9529-30]

17:40: **Multiple angle of incidence, spectroscopic, plasmon-enhanced, internal reflection ellipsometry for the characterization of solid-liquid interface processes**, Peter Petrik, Research Institute for Technical Physics and Materials Science (Hungary) and Univ. of Pannonia (Hungary); Emil Agocs, Benjamin Kalas, Peter Kozma, Research Institute for Technical Physics and Materials Science (Hungary); Balint Fodor, Judit Nador, Research Institute for Technical Physics and Materials Science (Hungary) and Univ. of Pécs (Hungary); Csaba Major, Research Institute for Technical Physics and Materials Science (Hungary); Miklos Fried, Research Institute for Technical Physics and Materials Science (Hungary) and Univ. of Pécs (Hungary) . . . . . [9529-31]

## POSTERS—TUESDAY

LOCATION: ICM FOYER . . . . . TUE 17:30 TO 19:00

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Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**Measurement of nanofluids absorption coefficient by Moiré deflectometry technique**, Khosro Madanipour, Amirkabir Univ. of Technology (Iran, Islamic Republic of); Ataollah Koohian, Univ. of Tehran (Iran, Islamic Republic of); Shahrzad Shahrabi Farahani, Amirkabir Univ. of Technology (Iran, Islamic Republic of) . . . . . [9529-32]

**Diffraction phase microscopy with transmission and reflection illumination for refractive index measurements**, Natalya A. Talaykova, Alexander L. Kalyanov, Vladimir P. Ryabukho, N.G. Chernyshevsky Saratov State Univ. (Russian Federation) . . . . . [9529-48]

**Study of optical waveguide sensor using metamaterial as buffer layer with non-linear cladding and substrate**, Santosh Kumar, Anamika Kumari, DIT Univ. (India); Sanjeev K. Raghuvanshi, Indian School of Mines (India) . [9529-49]

**Applicaton of speckle dynamics for studies of cell metabolism**, Alexander P. Vladimirov, Ural Federal Univ. (Russian Federation); Alexey Baharev, Research Institute of Viral Infections (Russian Federation); Alexander Malygin, Julia Mikhailova, Irina Novoselova, Dmitry I. Yakin, Ural Federal Univ. (Russian Federation) . . . . . [9529-50]

**Dynamic speckle-interferometer for intracellular processes analyses at high optical magnification**, Alexey Baharev, Research Institute of Virus Infections (Russian Federation); Alexander P. Vladimirov, Alexander Malygin, Julia Mikhailova, Irina Novoselova, Dmitry I. Yakin, Ural Federal Univ. (Russian Federation); Alexey Druzhinin, Institute of Metal Physics (Russian Federation) . . . . . [9529-51]

**Parameter optimization of phase microscope with the interferometer as a spatial phase modulator**, Olga A. Izotova, N.G. Chernyshevsky Saratov State Univ. (Russian Federation); Vladimir P. Ryabukho, N.G. Chernyshevsky Saratov State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation). . . . . [9529-52]

**Simple method of microorganism detection by using optical transmission and scattering techniques**, Takeshi Ishiyama, Ayata Takami, Toyohashi Univ. of Technology (Japan) . . . . . [9529-53]

**Investigation of surface irregularities of laser-treated metallic biomaterials based on light scattering measurement**, Sepehr Razi, Mahmoud Mollabashi, Iran Univ. of Science and Technology (Iran, Islamic Republic of); Khosro Madanipour, Amirkabir Univ. of Technology (Iran, Islamic Republic of) . [9529-54]

**Manual wavefront holography for inspection and visualization of engraved marks in progressive addition lenses**, Beatriz Perucho, Jose Angel Picazo-Bueno, Carlos Ferreira, Vicente Micó, Univ. de València (Spain) . . . . . [9529-55]

**Low-cost digital holographic microscope using webcam sensor and laser pointer**, Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India); Prachi Shah, Sardar Vallabhbhai National Institute of Technology (India); Swapnil Mahajan, Vismay Trivedi, Vani K. Chhaniwal, The Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (United States) . . . . . [9529-57]

**Design of rigid GRIN-endoscope with sapphire window and improved image quality**, Grzegorz V. Fluder, Warsaw Univ. of Technology (Poland) and National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Anna Voznesenskaya, Alexey Bakholdin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9529-58]

**Novel design of a refractive index sensor based on a dual-core micro-structured optical fiber**, George N. Tsigaridas, National Technical Univ. of Athens (Greece); Vassilis Karvouniaris, Peter Persephonis, Univ. of Patras (Greece); Alexander-Panagiotis A. Serafetinides, National Technical Univ. of Athens (Greece) . . . . . [9529-59]

## WEDNESDAY 24 JUNE

### SESSION 8

LOCATION: NOVOTEL-ROOM ZEPPELIN . . WED 8:50 TO 10:00

#### NOTE ROOM CHANGE

### Microscopy III

Session Chair: **Roberto Di Leonardo**, Sapienza Univ. di Roma (Italy)

8:50: **Dynamic speckle interferometry of intracellular processes: theory and features of application**, Alexander P. Vladimirov, Ural Federal Univ. (Russian Federation) and Research Institute of Virus Infections (Russian Federation) . . . . . [9529-33]

9:10: **In situ quantitation of collagen fibrils diameter using absolute measurements of second harmonic generation signals**, Stéphane Bancelin, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and INSERM (France); Carole Aimé, UPMC Sorbonne Univ. (France) and Ctr. National de la Recherche Scientifique (France); Ivan Gusachenko, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and INSERM (France); Laura Kowalczyk, UPMC Sorbonne Univ. (France) and INSERM (France); Gaël Latour, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and INSERM (France); Thibaud Coradin, UPMC Sorbonne Univ. (France) and Univ. Pierre et Marie Curie (France) and Ctr. National de la Recherche Scientifique (France); Marie-Claire Schanne-Klein, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and INSERM (France) . . . . . [9529-34]

9:30: **Time domain diffuse optical spectroscopy: In vivo quantification of collagen in breast tissue (Keynote Presentation)**, Paola Taroni, Antonio Pifferi, Giovanna Quarto, Andrea Farina, Politecnico di Milano (Italy); Francesca Ieva, Università degli Studi (Italy); Anna Maria Paganoni, Politecnico di Milano (Italy); Francesca Abbate, Enrico Cassano, European Institute of Oncology (Italy); Rinaldo Cubeddu, Politecnico di Milano (Italy) . . . . . [9529-35]

Coffee Break . . . . . Wed 10:00 to 10:30

### PLENARY SESSION

LOCATION: SAAL 1 . . . . . WED 10:30 TO 11:25

**Extreme Computational Imaging:  
Photography, Health-tech and Displays**

**Ramesh Raskar**, MIT Media Lab., United States

### SESSION 9

LOCATION: NOVOTEL-ROOM ZEPPELIN . . WED 11:30 TO 12:40

### Tomography

Session Chair: **Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (United States)

11:30: **FF-OCT as imaging tool for material, biochip- and microfluidic applications**, Bettina Heise, Boris Buchroithner, Paul J. Wagner, Johannes Kepler Univ. Linz (Austria); Mario Kanka, Rainer Riesenberger, Alexej Grjasnow, Leibniz-Institut für Photonische Technologien e.V. (Germany); David Sifter, Johannes Kepler Univ. Linz (Austria) . . . . . [9529-37]

11:50: **Full-field swept-source optical coherence tomography with phase-shifting techniques for skin cancer detection**, Johann Krauter, Tobias Boettcher, Klaus Körner, Marc Gronle, Wolfgang Osten, Institut für Technische Optik (Germany); Nicolas Passilly, Luc Froehly, Stéphane Perrin, Christophe Gorecki, Institut FEMTO-ST (France) . . . . . [9529-38]

12:10: **3D quantitative phase imaging techniques for the study of pathophysiology of cells and tissues (Invited Paper)**, YongKeun Park, KAIST (Korea, Republic of) . . . . . [9529-39]

Lunch Break . . . . . Wed 12:40 to 14:00

### SESSION 10

LOCATION: NOVOTEL-ROOM ZEPPELIN . WED 14:00 TO 15:30

### Optical Methods for Cell Characterization

Session Chair: **Laura Waller**, Univ. of California, Berkeley (United States)

14:00: **Raman spectroscopy in the diagnosis of acute leukemia**, Stefano Managò, National Research Council (Italy); Anna Chiara De Luca, Carmen Valente, Consiglio Nazionale delle Ricerche (Italy); Peppino Mirabelli, Istituto di Ricerca Diagnostica e Nucleare (Italy) . . . . . [9529-40]

14:20: **Spermatozoa quality assessment: a combined holographic and Raman microscopy approach**, Annalisa De Angelis, Maria Antonietta Ferrara, National Council of Research (Italy); Giuseppe Di Caprio, The Rowland Institute at Harvard (United States); Stefano Managò, National Research Council (Italy); Luigi Sirlito, Giuseppe Coppola, Anna Chiara De Luca, National Council of Research (Italy) . . . . . [9529-41]

14:40: **Design and validation of a multimodal low-budget Raman microscope for liquid and solid phase applications**, Hanna Koch, Kristina Noack, Stefan Will, Lehrstuhl für Technische Thermodynamik (Germany) and Erlangen Graduate School in Advanced Optical Technologies (Germany) . . . . . [9529-42]

15:00: **Multiscale mechanical characterization of biological materials (Invited Paper)**, Luciano Lamberti, Politecnico di Bari (Italy) . . . . . [9529-43]

Coffee Break . . . . . Wed 15:30 to 16:00

### SESSION 11

LOCATION: NOVOTEL-ROOM ZEPPELIN . WED 16:00 TO 17:30

### Sensing and Detection

Session Chair: **Enrique Tajahuerce**, Univ. Jaume I (Spain)

16:00: **Microgels for multiplex and direct fluorescence detection (Invited Paper)**, Filippo Causa, Univ. degli Studi di Napoli Federico II (Italy); Anna Aliberti, Angela Cusano, Edmondo Battista, Istituto Italiano di Tecnologia (Italy); Paolo A. Netti, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [9529-44]

16:30: **All optical indentation probe for endoscopic diagnosis of osteoarthritis**, Gabriele Marchi, Michael Jost, Albrecht Steinkopff, Hochschule für Angewandte Wissenschaften München (Germany); Carina Prein, Hochschule für angewandte Wissenschaften (Germany); Attila Aszodi, Ludwig-Maximilians-Univ. München (Germany); Hauke Clausen-Schaumann, Johannes Roths, Hochschule für Angewandte Wissenschaften München (Germany) . . . . . [9529-45]

16:50: **Differential self-mixing interferometry for micro-cantilever motion sensing**, Francisco J. Azcona Guerrero, Ajit Jha, Carlos R. Yañez, Santiago Royo, Univ. Politècnica de Catalunya (Spain) . . . . . [9529-46]

17:10: **Feasibility test of line sensors for optical tissue thickness estimation**, Patrick Stueber, Tobias Wissel, Benjamin Wagner, Achim Schweikard, Floris Ernst, Univ. zu Lübeck (Germany) . . . . . [9529-47]

# CONFERENCE 9530

LOCATION: ROOM 12B

Wednesday 24 June 2015 • Proceedings of SPIE Vol. 9530

## Automated Visual Inspection and Machine Vision

*Conference Chairs:* **Jürgen Beyerer**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Fernando Puente León**, Karlsruher Institut für Technologie (Germany)

*Programme Committee:* **Christian Frese**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Andreas Heinrich**, Hochschule Aalen (Germany); **Michael Heizmann**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Bernd Jähne**, Ruprecht-Karls-Univ. Heidelberg (Germany); **Thomas Längle**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Markus Maurer**, VITRONIC Dr.-Ing. Stein Bildverarbeitungssysteme GmbH (Germany); **Wolfgang Osten**, Univ. Stuttgart (Germany); **Felix Salazar**, Univ. Politécnica de Madrid (Spain); **Robert Schmitt**, Fraunhofer-Institut für Produktionstechnologie (Germany); **Hugo Thienpont**, Vrije Univ. Brussel (Belgium); **Stefan Werling**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Ernst Wiedenmann**, AiMESS Products GmbH (Germany); **Volker Willert**, Technische Univ. Darmstadt (Germany)

### TUESDAY 23 JUNE

#### POSTERS—TUESDAY

LOCATION: ICM FOYER ..... TUE 17:30 TO 19:00

Conference attendees are invited to attend the Optical Metrology Poster Session on Tuesday afternoon. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 10:00 hrs on Tuesday through 12:00 hrs on Thursday.

Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at <http://spie.org/x6513.xml>. (Follow the Special Events link)

**New opportunities of pegmatites enrichment by optical sorting**, Aleksandr N. Chertov, Elena V. Gorbunova, Artem A. Alekhin, Valery V. Korotaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Lyubov S. Skamnitckaya, Tatiana P. Bubnova, Institute of Geology (Russian Federation) ..... [9530-11]

**Modeling and analysis of the two-dimensional polystyrene aggregation process**, Krzysztof Skorupski, Wrocław Univ. of Technology (Poland); Imre Horvath, Maria Vetrano, Von Karman Institute (Belgium) ..... [9530-14]

**Fast interframe transformation with local binary patterns**, Boris V. Vishnyakov, Vladimir S. Gorbatshevich, Sergey V. Sidiyakin, GosNIIAS (Russian Federation) ..... [9530-19]

**The algorithm for generation of panoramic images for omnidirectional cameras**, Vasiliy P. Lazarenko, Sergey N. Yarishev, Valery V. Korotaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9530-20]

**Automatic online laser resonator alignment based on machine vision: analysis**, Lizhi Dong, Wenjin Liu, Ping Yang, Shuang Wang, Xing He, Bing Xu, Institute of Optics and Electronics (China) ..... [9530-21]

**Control system of warehouse robots' position**, Ivan Maruev, Eugene G Lebedko, Anton V Nikulin, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9530-22]

**A novel regularization method for optical flow-based head pose estimation**, Sebastian Vater, Guillermo Mann, Fernando Puente León, Karlsruher Institut für Technologie (Germany) ..... [9530-23]

**Accurate invariant pattern recognition for perspective camera model**, Mariya G. Serikova, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Ekaterina N. Pantyushina, ITMO University (Russian Federation); Vadim V. Zyuzin, Valery V. Korotaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Joel J. P. C. Rodrigues, Instituto de Telecomunicações (Portugal) and National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9530-24]

**Stereo sequences analysis for dynamic scene understanding in a driver assistance system**, Boris V. Vishnyakov, Yury V. Vizilter, Vladimir A. Knyaz, Ivan K. Malin, Oleg V Vygolov, Sergey Y. Zheltov, GosNIIAS (Russian Federation) ..... [9530-25]

**Image restoration using aberration taken by a Hartmann wavefront sensor on extended object, towards real-time deconvolution**, Ahmad Darudi, Hadi Bakhshi, Reza Asgari, Univ. of Zanjan (Iran, Islamic Republic of) ..... [9530-26]

**A FragTrack algorithm enhancement for total occlusion management in visual object tracking**, Francesco Adamo, Pier L. Mazzeo, Paolo Spagnolo, Cosimo Distante, Consiglio Nazionale delle Ricerche (Italy) ..... [9530-27]

### WEDNESDAY 24 JUNE

#### SESSION 1

LOCATION: ROOM 12B ..... WED 8:10 TO 10:00

#### Measurement

Session Chair: **Jürgen Beyerer**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

8:10: **Camera series and parallel networks for deformation measurements of large scale structures** (*Invited Paper*), Qifeng Yu, Yang Shang, Bang lei Guan, Zhi hui Lei, Xiao lin Liu, National Univ. of Defense Technology (China) ..... [9530-1]

8:40: **Extending critical dimension measurement for optical microlithography with robust SEM image contours**, Francois Weisbuch, GLOBALFOUNDRIES Dresden Module Two, GmbH & Co. KG (Germany) ..... [9530-2]

9:00: **Towards one trillion positions**, Tobias Haist, Marc Gronle, Duc Anh Bui, Bofan Jiang, Christof Pruss, Frederik Schaal, Wolfgang Osten, Institut für Technische Optik (Germany) ..... [9530-3]

9:20: **Application of a reflectance model to the sensor planning system**, Tomáš Kouřecký, David Paloušek, Jan Brandejs, Brno Univ. of Technology (Czech Republic) ..... [9530-4]

9:40: **The application of vision measurement in aerodynamic testing combined with speckle correlation**, Ding Chen, Jing-guo Zhang, Ye-hua Zhang, Wei Wang, Hong-qiang Ma, Shang-bin Zhang, Jia-bo Feng, China Academy of Aerospace Aerodynamics (China) ..... [9530-5]

Coffee Break ..... Wed 10:00 to 10:30

#### PLENARY SESSION

LOCATION: SAAL 1 ..... WED 10:30 TO 11:25

**Extreme Computational Imaging:  
Photography, Health-tech and Displays**

**Ramesh Raskar**, MIT Media Lab., United States

#### SESSION 2

LOCATION: ROOM 12B ..... WED 11:30 TO 12:20

#### Multispectral Inspection

Session Chair: **Fernando Puente León**, Karlsruher Institut für Technologie (Germany)

11:30: **Research of the fusion methods of the multispectral optoelectronic systems images** (*Invited Paper*), Aleksandr S. Vasilev, Valery V. Korotaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9530-6]

12:00: **A new indicator in early drought diagnosis of cucumber with chlorophyll fluorescence imaging**, Heng Wang, Haifeng Li, Liang Xu, Xu Liu, Zhejiang Univ. (China) ..... [9530-7]

Lunch Break ..... Wed 12:20 to 14:20



**SESSION 3**

LOCATION: ROOM 12B ..... WED 14:20 TO 15:30

**Optical Sorting**Session Chair: **Jürgen Beyerer**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

14:20: **Spatial regularization for the unmixing of hyperspectral images** (*Invited Paper*), Sebastian Bauer, Florian Neumann, Fernando Puente León, Karlsruher Institut für Technologie (Germany) ..... [9530-9]

14:50: **Identification and sorting of regular textures according to their similarity**, Pilar Hernandez Mesa, Johannes Anastasiadis, Fernando Puente León, Karlsruher Institut für Technologie (Germany) ..... [9530-10]

15:10: **The influence of the design features on optical sorter effectiveness**, Nikita A. Pavlenko, Valery V. Korotaev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) ..... [9530-12]

Coffee Break ..... Wed 15:30 to 16:00

**SESSION 4**

LOCATION: ROOM 12B ..... WED 16:00 TO 17:40

**Inspection, Monitoring and Detection**Session Chair: **Fernando Puente León**, Karlsruher Institut für Technologie (Germany)

16:00: **Investigation into the use of smartphone as a machine vision device for engineering metrology and flaw detection, with focus on drilling**, Vikram Razdan, Richard Bateman, Brunel Univ. (United Kingdom) ..... [9530-13]

16:20: **Range imaging behind semi-transparent surfaces by high-speed modulated light**, Dave Geerardyn, Hans Ingelberts, Robin Deleener, Maarten Kuijk, Vrije Univ. Brussel (Belgium) ..... [9530-15]

16:40: **Retroreflective microprismatic materials in image-based control applications**, Mariya G. Serikova, Anton V. Pantyushin, Elena V. Gorbunova, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Andrei G. Anisimov, Technische Univ. Delft (Netherlands) ..... [9530-16]

17:00: **Object recognition in 3D point clouds with maximum likelihood estimation**, Harshana G. Dantanarayana, Jonathan M. Huntley, Loughborough Univ. (United Kingdom) ..... [9530-17]

17:20: **Automatic detection system of shaft part surface defect based on machine vision**, Lixing Jiang, Zhengzhou Institute of Surveying and Mapping (China); Kuoyuan Sun, Fulai Zhao, Zhengzhou Institute of Surveying and Mapping, China (China); Xiangyang Hao, Zhengzhou Institute of Surveying and Mapping (China) ..... [9530-18]

# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

## A

Abbas, Mohammed T. [9526-11] S3  
Abbate, Francesca [9529-35] S8  
**Abdula, Polina A.** [9526-62] SPS  
Abe, Ryosuke [9525-19] S4  
Abolhassani, Mohammad [9525-159] SPS  
Adam, Aurèle J. L. [9527-8] S2  
Adamo, Francesco [9530-27] SPS  
Adams, Alvin [9525-72] S14  
**Adinda-Ougba, Adamou** [9529-2] S1  
Afrough, Mohsen [9525-39] S8  
Aghemo, Chiara [9527-20] S5  
Agocs, Emil [9526-27] S7, [9529-31] S7  
Agulló-López, Fernando [9529-25] S6  
Ahmadabadian, Ali H. [9528-18] S4  
Ahmadi, Mohammad [9526-26] SPS  
Aimé, Carole [9529-34] S8  
Akturk, Selcuk [9527-2] S1  
Alatawi, Ayshah [9525-54] S11  
Albert, Sven [9525-39] S8  
**Albertazzi Gonçalves, Armando** 9525 Conference CoChair, 9525 S15 Session Chair, [9525-28] S6, [9525-30] S6  
Alcázar de Velasco, Angel [9529-25] S6  
**Alekhin, Artem A.** [9530-11] SPS  
Al-Hadhrani, Luai Mohammed [9526-11] S3  
Aliberti, Anna [9529-44] S11  
Allegre, Lisa [9525-49] S10  
Alves, Márcia Angelina [9527-29] SPS  
**Ambrosini, Dario** 9527 Program Committee, [9527-17] S4  
Ambrosio, Luigi 9529 Program Committee  
**Amphawan, Angela** [9525-80] SPS  
Anand, Arun [9525-122] SPS, [9525-139] SPS, [9529-57] SPS  
Anastasiadis, Johannes [9530-10] S3  
Ando, Shigeru [9525-43] S9  
Andrianakis, Michalis [9527-28] S6  
Angelsky, Oleg V. 9525 Program Committee  
**Anisimov, Andrei G.** [9525-42] S8, [9530-16] S4  
Anstotz, Freddy [9528-11] S2  
Antunovic, Jan [9529-8] S3  
Ao, Mingwu [9526-40] S9, [9526-9] S2  
Apedo, Komla [9525-34] S7  
**Arai, Yasuhiko** [9525-31] S6  
**Arasa, Josep** [9525-81] S15  
Arciniegas, Javier R. [9525-157] SPS  
**Arrizabalaga, Oskar** [9525-15] SPS  
Arrue, Jon [9525-71] S14  
Artemenko, Yury [9525-143] SPS  
Ascaso, Carmen [9527-1] S1  
Aschermann, Lars [9525-37] S8  
Asfour, Jean-Michel 9525 S10  
Session Chair, 9525 S11 Session Chair, [9525-55] S11  
**Asgari, Pegah** [9525-151] SPS  
Asgari, Reza [9530-26] SPS  
Asmus, John F. 9527 Program Committee  
**Asoubar, Daniel** [9526-17] S4  
**Asundi, Anand Krishna** 9525 Program Committee  
Aszodi, Attila [9529-45] S11

**Attota, Ravikiran** [9525-4] S1  
**Ayubi, Gastón A.** [9525-113] SPS  
**Azcona Guerrero, Francisco J.** [9525-70] S14, [9529-46] S11

## B

Baer, Goran Bastian [9525-50] S10  
Baharev, Alexey [9529-50] SPS, [9529-51] SPS  
Bai, Yunbo [9525-111] SPS  
Bailly, Yannick [9525-117] SPS, [9525-141] SPS  
Baker, Harlyn [9528-2] S1  
Bakholdin, Alexey [9529-58] SPS  
**Bakshi, Hadi** [9530-26] SPS  
Ballarin, Martina [9528-40] SPS  
Balletti, Caterina [9527-23] S5, [9528-40] SPS  
**Bancelin, Stéphane** [9529-34] S8  
Bär, Markus 9526 Program Committee, [9526-29] S7  
Bardeau, Jean-François [9525-7] S2  
Barnes, Bryan M. [9526-30] S7  
**Barroso Peña, Alvaro** [9529-26] S6  
Barsukov, Oleg [9525-145] SPS  
Barucci, Marco [9527-36] SPS  
Baselt, Tobias [9525-14] S3, [9525-142] SPS, [9525-24] S5  
Bateman, Richard [9530-13] S4  
Battista, Edmondo [9529-44] S11  
Bauer, Sebastian [9530-9] S3  
**Bäumer, Stefan M.** [9526-23] S5  
Bechen, Benjamin [9525-67] S13  
Bednarz, Lukasz Jan [9527-13] S3  
**Beitia, Carlos** [9525-4] S1  
**Belashov, Andrey V.** [9525-138] SPS, [9529-15] S4  
Bella, José L. [9529-25] S6  
Beloki, Josu [9525-71] S14  
Beltrame, Carlo [9527-23] S5  
Beraldin, Jean-Angelo 9528 Program Committee, [9528-28] S7  
Berger, Uwe [9525-65] S13  
**Bergmann, Ralf B.** 9525 Program Committee  
Bernikola, Eirini [9527-22] S5, [9527-28] S6  
Bethmann, Folkmar [9528-24] S6  
Bettenworth, Dominik [9529-3] S1  
**Beuth, Thorsten** [9526-14] S4, [9526-8] S2  
**Beverage, Jake L.** [9526-37] S9  
**Beyerer, Jürgen** [9525-33] S7, 9530 Conference Chair, 9530 S1 Session Chair, 9530 S3 Session Chair  
Bianchi, Silvio [9529-23] S6  
Bianco, Vittorio [9529-16] S4, [9529-29] S7  
**Bichra, Mohamed** [9525-52] S11  
Biegen, James F. [9525-22] S5  
Bischoff, Jörg 9526 Program Committee  
**Bisht, Akanksha** [9525-80] SPS  
**Bisht, Ashish** [9525-80] SPS  
Bittkau, Karsten [9526-33] S8  
Blobel, Gernot [9525-51] S11  
Blum, Oliver [9528-2] S1  
Bodenstorfer, Ernst [9525-67] S13  
Bodermann, Bernd 9526 Conference Chair, 9526 SJS Session Chair, [9526-27] S7, [9526-28] S7, [9526-29] S7  
Bodnar, Jean-Luc [9527-22] S5  
Boehm, Jan 9528 Program Committee  
Boesemann, Werner 9528 Program Committee

Boettcher, Tobias [9529-38] S9  
Bongs, Kai [9528-42] S1  
Boochs, Frank [9528-4] S1, [9528-8] S3  
Borzoki, Hamid Razavi [9525-148] SPS  
Bosse, Harald 9525 Program Committee, 9526 Program Committee  
**Boulanger, Sven** [9528-31] S7  
**Bouzin, Margaux** [9529-9] S3  
**Bowen, John W.** [9527-21] S5, [9527-22] S5  
Bradu, Adrian [9525-8] S2  
Brandejs, Jan [9525-41] S8, [9530-4] S1  
Bräuer-Burchardt, Christian [9526-4] S2, [9528-12] S2, [9528-13] S2  
Braun, Jaroslav [9525-93] SPS, [9528-34] SPS  
Brockherde, Werner [9525-67] S13  
Brodersen, Joerg [9525-67] S13  
Brown, William P. [9527-25] S3  
Brunetti, Bruno G 9527 Program Committee, 9527 S1 Session Chair  
Bubnova, Tatiana P. [9530-11] SPS  
Buchroithner, Boris [9529-37] S9  
**Buchta, Dominic** [9527-27] S6  
Buckley, Simon 9528 Program Committee  
Budde, Björn [9529-11] S2  
Buhr, Egbert 9526 S5 Session Chair  
Bui, Duc Anh Meeting VIP, [9530-3] S1  
**Burger, Sven** 9526 Program Committee, 9526 S1 Session Chair, [9526-28] S7  
Burgos, Héctor [9529-25] S6

## C

Calabuig-Barroso, Alejandro [9529-12] S2, [9529-20] S5  
**Campos, Juan** [9526-38] S9, [9526-46] S10, [9526-47] S10  
Cano, Emilio [9527-3] S1  
Cao, Zhao [9526-33] S8  
Carius, Reinhard [9526-33] S8  
Carrascosa, Mercedes [9529-25] S6  
Casarin, R. [9525-60] S12  
Casillas, Francisco J. [9526-39] S9  
Cassano, Enrico [9529-35] S8  
Castillejo, Marta 9527 Program Committee, 9527 S3 Session Chair, [9527-1] S1, [9527-3] S1  
Causa, Filippo [9529-44] S11, [9529-7] S3  
Cavalli, Silvia [9529-20] S5  
Ceffa, Nicolo' Giovanni [9529-9] S3  
Chabane, Abderrahim [9527-30] SPS  
Chang, Cheng-Yi [9528-41] SPS  
Chang, Chir-Weei [9528-41] SPS  
Chang, Po-Yi [9525-46] SPS  
**Charleston, Sean A.** [9528-29] S7  
Charrett, Thomas O. H. [9525-59] S12, [9525-72] S14  
Chelibanov, Vladimir P. [9526-10] S3  
Chen, Bo [9525-100] S9  
Chen, Ding [9530-5] S1  
Chen, Jin-Ping [9525-36] S7  
**Chen, Qian** [9525-83] SPS  
**Chen, Xiuguo** [9526-42] S10, [9526-43] S10, [9526-44] S10, [9526-45] S10  
Chen, Xiuguo [9526-42] S10, [9526-43] S10, [9526-44] S10, [9526-45] S10  
Cheng, Chau-Jern 9525 Program Committee  
Chertov, Aleksandr N. [9530-11] SPS  
Cheung, Chi Shing [9527-16] S4, [9527-5] S2  
Chhaniwal, Vani K. [9525-122] SPS, [9525-139] SPS, [9529-57] SPS  
Chiarantini, Leandro [9527-26] S6  
Chikatsu, Hirofumi [9528-39] SPS  
Chirico, Giberto 9529 S4 Session Chair  
Chirico, Giuseppe [9529-9] S3  
**Chlipala, Maksymilian** [9527-11] S3  
**Chugui, Yuri V.** 9525 Program Committee  
**Číp, Ondřej** [9525-164] SPS, [9525-165] SPS, [9525-166] SPS, [9525-167] SPS  
**Cisotto, Luca** [9526-3] S1  
Čížek, Martin [9525-164] SPS, [9525-167] SPS  
Claridge, Ela [9528-42] S1  
Clarkson, W. Andrew [9527-5] S2  
Clausen-Schaumann, Hauke [9529-45] S11  
Claveau, Rémy [9528-11] S2  
Clemente Pseudo, Pedro J. [9529-28] S7  
Climent Jordá, Vicent [9529-28] S7  
Cocola, Lorenzo [9525-60] S12  
Coene, Wim M.J. 9525 Program Committee  
Collini, Maddalena [9529-9] S3  
Conover, Damon M. [9527-15] S4  
Contreras Pico, Carlos Ricardo [9525-157] SPS, [9525-158] SPS  
Cooper, Jonathan M. 9529 Program Committee  
Coppola, Giuseppe [9529-41] S10  
Coradin, Thibaud [9529-34] S8  
Cornet, Alain [9525-11] S2  
Correns, Martin [9525-124] SPS  
Cossairt, Oliver [9526-100] SJS  
Costa, Elisa [9527-23] S5  
Costil, Sophie [9525-121] SPS  
Cournoyer, Luc [9528-28] S7  
Cree, Michael J. [9528-29] S7  
Cremonese, Gabriele [9528-26] S6  
**Cubeddu, Rinaldo** [9529-35] S8  
Cucci, Costanza [9527-26] S6  
**Curticapean, Dan** [9525-160] SPS  
Cusano, Angela Maria [9529-44] S11  
**Czarske, Jürgen W.** 9525 Program Committee, 9525 S12 Session Chair, [9525-66] S13  
**Czyz, Krzysztof** [9527-34] SPS

## D

Da Deppo, Vania [9528-26] S6  
Daffara, Claudia 9527 S2 Session Chair, [9527-12] S3, [9527-19] S5, [9527-36] SPS  
D'Alfonso, Laura [9529-9] S3  
**Daniel, Jae M. O.** [9527-5] S2  
Dannhauser, David [9529-7] S3  
Dantanarayana, Harshana G. [9530-17] S4  
Darudi, Ahmad [9525-151] SPS, [9530-26] SPS  
Davin, Tanguy [9525-117] SPS, [9527-30] SPS  
Dawson, Peter [9528-9] S3  
Dazzi, Alexandre [9527-9] S6  
De Angelis, Annalisa [9529-41] S10

# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

**de Groot, Peter J.** 9525 Program Committee, 9525 S7 Session Chair, [9525-22] S5, [9526-37] S9  
de los Ríos, Asunción [9527-1] S1  
De Luca, Anna Chiara [9529-40] S10, [9529-41] S10  
de Tagle, Alberto 9527 Program Committee  
Delaney, John K. 9527 Program Committee, [9527-15] S4, [9527-25] S3  
Deleener, Robin [9530-15] S4  
Delorme, Nicolas [9525-7] S2  
Deniset-Besseau, Ariane [9527-9] S6  
Denisov, Victor M. [9525-131] SPS, [9525-162] SPS  
**Denz, Cornelia** 9529 S5 Session Chair, [9529-26] S6  
**Désage, Simon-Frédéric** [9525-75] S15  
Detalle, Vincent [9527-21] S5, [9527-22] S5  
Detchev, Ivan [9528-32] S7  
Deutz, Alex [9526-23] S5  
**Dholakia, Kishan** 9529 S6 Session Chair, [9529-10] S2  
di Bernardo, Diego 9529 Program Committee  
Di Caprio, Giuseppe [9529-41] S10  
Di Leonardo, Roberto 9529 S8 Session Chair, [9529-23] S6  
**Diaspro, Alberto** 9529 Program Committee  
Diebold, Maximilian [9528-2] S1  
Dietrich, Patrick [9525-40] S8, [9528-12] S2  
**Dingemans, Liesbeth M.** [9527-8] S2  
Dirckx, Joris 9525 S14 Session Chair, [9525-62] S13  
Distante, Cosimo [9525-20] S4, [9530-27] SPS  
Domagk, Dirk [9529-3] S1  
Dondi, Piercarlo [9527-18] S4  
Dong, Lizhi [9526-40] S9, [9526-9] S2, [9530-21] SPS  
Dooley, Kathryn [9527-15] S4  
**Dorrington, Adrian A.** [9528-29] S7  
**Doumont, Jean-luc** WS897, WS908  
Drabarek, Pawel J. [9525-23] S5  
Dreiden, Galina V. [9525-138] SPS  
Drobczynski, Sławomir [9526-58] SPS  
Druzhinin, Alexey [9529-51] SPS  
Du, Weichao [9526-44] S10  
Dubois, Frank 9529 Program Committee  
Dudenkova, Varvara [9529-30] S7  
Dufour, Marc L. [9525-13] S3  
Durana, Gaizka [9525-15] SPS  
Dürr, Detlef [9526-64] SPS

## E

**E, Kewei** [9525-32] S6  
Edely, Mathieu [9525-7] S2  
**Egorov, Dmitry I.** [9525-149] SPS  
Eifler, Matthias M [9525-163] S7  
El-Badry, Mamdouh [9528-32] S7  
Elster, Clemens [9525-51] S11  
Elvira, Iris [9529-25] S6  
Endres, Johannes [9526-27] S7  
Eriksson, Johan [9526-13] S3  
Ermes, Markus [9526-33] S8  
**Ermolaev, Petr A.** [9525-108] SPS, [9525-94] SPS  
Ernst, Floris [9529-47] S11

Ershov, Alexandr G. [9526-48] SPS  
Ersoy, Tansu [9527-2] S1  
Ertmer, Wolfgang A. 9529 Program Committee  
Essaidi, Aissam [9529-2] S1  
**Estevez Caride, Irene** [9526-46] S10, [9526-47] S10  
**Ettemeyer, Andreas** [9525-35] S15  
Evanschitzky, Peter 9526 Program Committee  
Ezhova, Ksenia [9526-52] SPS, [9526-56] SPS

## F

Falaggis, Konstantinos [9525-2] S1  
**Farina, Andrea** [9529-35] S8  
Favrelière, Hugues [9525-75] S15  
Fedel, Massimo [9525-60] S12  
Feng, Jia-bo [9530-5] S1  
**Feng, Shijie** [9525-83] SPS  
Fernández Fernández, José Luis [9525-11] S2  
Ferrara, Maria Antonietta [9529-41] S10  
**Ferraro, Pietro** 9525 Program Committee, [9525-18] S4, [9525-20] S4, 9529 Conference Chair, [9529-12] S2, [9529-16] S4, [9529-19] S5, [9529-20] S5, [9529-24] S6, [9529-29] S7, [9529-6] S3, [9529-7] S3  
**Ferreira, Carlos** [9525-140] SPS, [9529-13] S2, [9529-55] SPS  
Feugeas, Françoise [9525-34] S7  
Filatov, Yuri V. [9525-129] SPS  
Fischer, Andreas [9525-66] S13  
Fischer, Martin C. [9527-25] S3  
Fluder, Grzegorz W. [9529-58] SPS  
Flury, Manuel [9528-11] S2  
Fodor, Balint [9526-27] S7, [9529-31] S7  
Fond, Christophe [9525-34] S7  
**Fontana, Filipe** [9525-30] S6  
Fontana, Raffaella E. M. 9527 Program Committee, [9527-36] SPS  
Forbes, Gregory W. [9525-47] S10  
Forlani, Gianfranco [9528-26] S6  
Forteimer, Ines [9525-51] S11  
**Fox, Maik** [9526-14] S4, [9526-8] S2  
Freijo Martín, Idoia [9526-7] S2  
Frenner, Karsten 9526 Conference CoChair, 9526 S8 Session Chair, [9526-36] S8  
Frese, Christian 9530 Program Committee  
Fried, Miklos [9525-64] S13, [9526-27] S7, [9529-31] S7  
Fries, Thomas [9526-25] S6  
Froehly, Luc [9529-38] S9  
Fu, Hongyuan [9525-112] SPS  
Fu, Liwei 9526 S3 Session Chair, [9526-36] S8  
Fu, Xing [9525-36] S7  
**Fu, Yu** [9525-73] S14  
Fulai, Zhao [9525-116] SPS  
Furlong, Cosme 9525 Program Committee  
Fusco, Sabato [9529-24] S6  
Fuse, Takashi 9528 Program Committee, 9528 S2 Session Chair, [9528-6] S3

## G

Gao, Chunfeng [9525-79] SPS  
Gao, Hongwen [9525-105] SPS  
Gao, Peng 9525 S5 Session Chair, [9525-169] S4  
Garbe, Christoph S. [9528-2] S1

**García, Iker** [9525-71] S14  
García-Cabañes, Angel [9529-25] S6  
García-Monreal, Javier [9525-137] SPS, [9525-140] SPS, [9529-13] S2, [9529-14] S2  
García-Sucerquia, Jorge [9525-7] S2  
Garnica, Guillermo [9528-14] S2  
Gauthier, Bruno [9525-13] S3  
Gautier, François [9525-69] S14  
**Geerardyn, Dave** [9528-31] S7, [9530-15] S4  
Gehrmann, Julia [9528-10] S2  
Gennari, Oriella [9529-19] S5, [9529-29] S7  
**Georges, Marc P.** 9525 Program Committee, 9525 S13 Session Chair, [9525-57] S12  
Georgopoulos, Andreas [9528-7] S3  
**Gerhardt, Nils C.** [9529-2] S1  
Giachetti, Andrea [9527-12] S3  
Gianto, Gianto [9525-34] S7  
Giovannacci, David [9527-21] S5, [9527-22] S5  
Gladkovskiy, Sergey V. [9525-77] S15  
Glennapp, Carsten [9525-45] S9  
Glebov, Victor [9526-49] SPS  
Gobbetti, Enrico [9527-12] S3  
Gollor, Pascal [9525-25] S5  
González Gómez, Andrés Leonardo [9525-161] S9  
Gorbachev, Alexey A. [9525-156] SPS  
Gorbatshevich, Vladimir [9530-19] SPS  
Gorbunova, Elena V. [9530-11] SPS, [9530-16] S4  
**Gorecki, Christophe** 9525 Program Committee, [9529-38] S9  
Goto, Kazufumi [9525-19] S4  
Grammatikopoulos, Lazaros [9528-25] S6, [9528-27] S6  
**Granero Montagud, Luis** [9525-137] SPS, [9525-140] SPS  
Granet, Gérard [9526-101] SJS  
Greborio, L. [9525-168] SPS  
Grilli, Simonetta 9529 Conference Chair, [9529-12] S2, [9529-20] S5  
Grjasnow, Alexej [9529-37] S9  
Gronle, Marc [9525-74] S15, [9529-38] S9, [9530-3] S1  
Gross, Hermann A. [9526-29] S7  
**Groves, Roger M.** [9525-42] S8, 9527 Program Committee, 9527 S4 Session Chair, [9527-8] S2, 9529 Program Committee, 9529 S3 Session Chair, [9529-21] S5  
Grübler, Till [9525-23] S5  
Gruppetta, Stephen [9526-34] S8, [9528-42] S1  
Grussenmeyer, Pierre [9528-16] S4  
Grzesiak, Andrzej [9525-65] S13  
**Gu, Honggang** [9526-43] S10, [9526-45] S10  
Gu, Yue [9525-36] S7  
Guan, Banglei [9530-1] S1  
Guan, Banglei [9528-35] SPS  
Guarnieri, Alberto [9527-35] SPS  
Guck, Jochen R. 9529 Program Committee  
Guerra, Francesco [9527-23] S5, [9528-40] SPS  
Guida, Géraldine [9527-30] SPS  
**Guidi, Gabriele** 9528 Program Committee  
**Guo, Guangrao** [9525-32] S6

**Guo, Tong** [9525-36] S7  
Guo, Tong [9525-86] SPS, [9525-88] SPS  
Gurov, Igor P. [9525-94] SPS, 9527 Program Committee  
Gusachenko, Ivan [9529-34] S8  
Gusarov, Vadim [9525-155] SPS  
Gutsche, Marcel [9528-2] S1

## H

Hæggström, Edward [9525-126] SPS, [9525-84] SPS  
Hafner, Christian 9526 Program Committee  
Haist, Tobias [9525-74] S15, [9530-3] S1  
Hao, Xiangyang [9525-116] SPS, [9530-18] S4  
Hartmann, Peter [9525-14] S3, [9525-142] SPS, [9525-24] S5  
Hatzigiannakis, Kostas [9527-22] S5, [9527-28] S6  
**Hayasaki, Yoshio** 9525 Program Committee, [9525-19] S4, [9525-3] S1  
He, Jianguo [9525-10] S2  
He, Xin [9525-89] SPS  
He, Xing [9530-21] SPS  
Heidenreich, Sebastian [9526-29] S7  
Hein, Niclas [9527-27] S6  
Heinrich, Andreas 9530 Program Committee  
Heinrich, Andreas [9525-65] S13  
Heinze, Matthias [9528-13] S2  
**Heise, Bettina** [9529-37] S9  
Heist, Stefan [9525-40] S8, [9528-12] S2  
Heizmann, Michael 9530 Program Committee  
Hellmann, Christian [9526-17] S4  
Henn, Mark-Alexander [9526-30] S7  
Hering, Jan [9525-163] S7  
Hernández Mesa, Pilar [9530-10] S3  
**Hernández-Romo, Martin** [9525-147] SPS, [9525-153] SPS  
Hervé, Philippe J. L. [9525-117] SPS, [9525-141] SPS, [9527-30] SPS  
Hess, Mona [9528-17] S4  
Hirschl, Christina [9525-24] S5  
Hoang, Van Phong [9525-143] SPS  
Hoffmann, Rolf [9525-125] SPS  
Hofmann, Martin R. [9529-2] S1  
**Holá, Miroslava** [9525-165] SPS, [9525-166] SPS  
Holzapfel, Wolfgang 9526 Program Committee, 9526 S4 Session Chair  
Holzhüter, Hanno [9526-19] S4  
Hörner, Florian [9529-26] S6  
Horvath, Imre [9530-14] SPS  
Horvath, Zoltan G. [9525-64] S13  
Houta, Faiza [9526-25] S6  
**Hrabina, Jan** [9525-164] SPS, [9525-165] SPS, [9525-166] SPS, [9525-167] SPS  
Hu, Guohang [9525-109] SPS  
Hu, Xiaotang [9525-36] S7  
Huang, Yongle [9525-66] S13  
**Hucl, Václav** [9525-164] SPS, [9525-167] SPS  
**Huke, Philipp** [9526-19] S4  
Hulsen, Bas [9525-53] S11  
Huntley, Jonathan Mark [9530-17] S4



# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

I  
Iacomussi, Paola [9527-20] S5, [9527-24] S5  
Ibarrá-Castanedo, Clemente [9527-17] S4  
Iemmi, Claudio C. [9526-38] S9, [9526-46] S10  
Ieva, Francesca [9529-35] S8  
**Ingelberts, Hans** [9530-15] S4  
Invernizzi, Claudia [9527-18] S4  
Isbach, Michael [9529-11] S2  
Ishanin, Gennady G. [9526-10] S3  
**Ishikawa, Shinji** [9525-3] S1  
Ishiyama, Takeshi [9525-120] SPS, [9529-53] SPS  
**Itoh, Kazuyoshi** Meeting VIP  
Ivashchenko, Elena [9525-85] SPS  
Iwanicka, Magdalena A. [9527-7] S2  
**Izotova, Olga A.** [9529-52] SPS

J  
Jackson, J. Bianca [9527-21] S5, [9527-22] S5  
**Jähne, Bernd** [9528-1] S1, [9528-2] S1, 9530 Program Committee  
Jahraus, Adam V. [9528-9] S3  
Jain, Pranay [9525-154] SPS  
James, Stephen W. [9525-72] S14  
Jasienko, Jerzy [9527-13] S3  
Javadianvarjovi, Soheila [9525-130] SPS, [9526-26] SPS  
**Javidi, Bahram** [9525-122] SPS, [9525-137] SPS, [9525-18] S4, [9529-57] SPS  
Jha, Ajit [9525-70] S14, [9529-46] S11  
Ji, Fang [9525-10] S2  
Jia, Xin [9526-57] SPS  
Jian, Zhou [9525-79] SPS  
Jiang, Bofan [9530-3] S1  
Jiang, Hao [9526-42] S10, [9526-43] S10, [9526-44] S10, [9526-45] S10  
Jiang, Lixing [9525-116] SPS, [9530-18] S4  
Jin, Chunshui [9525-56] S11  
Jin, Chunxiang [9525-111] SPS  
Joo, Ki-Nam [9525-6] S2  
Jordt, Andreas [9528-19] S5  
Jost, Michael [9529-45] S11  
Juberá, Mariano [9529-25] S6  
Juhasz, Gyorgy [9525-64] S13, [9526-27] S7

K  
Kahl, Michael [9525-35] S15  
Kajdewicz, Irmína [9528-5] S1  
Kalas, Benjamin [9529-31] S7  
Kalisperakis, Ilias [9528-25] S6, [9528-27] S6  
Kalkandjiev, Todor K. [9526-46] S10  
Kalyanov, Alexander L. [9529-48] SPS  
Kamantsev, Ivan S. [9525-77] S15  
Kamiya, Keita [9528-6] S3  
Kang, HyeongGon [9525-4] S1  
Kanka, Mario [9529-37] S9  
**Karimov, Konstantin A.** [9528-37] SPS  
Karmacharya, Ashish [9528-4] S1  
Karras, George I. [9528-27] S6  
Kavouniaris, Vassiliis [9529-59] SPS  
**Kassamakov, Ivan** [9525-126] SPS, [9525-84] SPS  
Kastl, Lena [9529-1] S1, [9529-11] S2

Kästner, Markus [9525-26] S5, [9525-38] S8  
Katelevsky, Vadim Ya. [9525-92] SPS  
**Kemper, Björn** 9529 S7 Session Chair, [9529-1] S1, [9529-11] S2, [9529-3] S1, [9529-8] S3  
Ketelhut, Steffi [9529-1] S1, [9529-3] S1  
Khalil, Abdallah M. [9528-36] SPS  
**Khan, Mohammed Zia Ullah** [9526-11] S3  
Khani, Mohammad Reza [9525-148] SPS  
Kim, Byeong Kwon [9525-6] S2  
**Kim, Myung K.** 9525 Program Committee  
**Kim, Myun-Sik** [9525-49] S10  
Kissinger, Thomas [9525-72] S14  
Kleemann, Bernd H. 9526 Program Committee  
**Kleshchenok, Maksim A.** [9525-136] SPS, [9525-68] S13  
Kline, R. Joseph [9525-5] SPS  
**Kniaz, Vladimir V.** [9528-21] S5  
**Knyaz, Vladimir A.** [9530-25] SPS  
**Koch, Alexander W.** [9525-63] S13  
Koch, Edmund [9525-24] S5  
Koch, Hanna [9529-42] S10  
Koch, Reinhard [9528-19] S5  
**Kogou, Sotiria** [9527-16] S4  
**Konyakhin, Igor A.** [9525-101] SPS, [9525-143] SPS, [9525-145] SPS, [9525-146] SPS, [9525-68] S13, [9525-91] SPS, [9526-15] S4, [9526-52] SPS, [9526-55] SPS  
Koochian, Ataollah [9529-32] SPS  
Körner, Klaus D. [9529-38] S9  
**Korolkov, Victor P.** [9525-55] S11  
**Korotaev, Valery V.** [9525-107] SPS, [9525-131] SPS, [9525-136] SPS, [9525-156] SPS, [9525-162] SPS, [9525-99] SPS, [9530-11] SPS, [9530-12] S3, [9530-20] SPS, [9530-24] SPS, [9530-6] S2  
Kossolapov, Alexander J. 9527 Program Committee  
**Kostencka, Julianna** [9525-21] S4  
Koukourakis, Nektarios [9529-2] S1  
**Koutecký, Tomáš** [9530-4] S1  
Kowalczyk, Laura [9529-34] S8  
Kowarschik, Richard 9525 Program Committee  
Kozacki, Tomasz 9525 Program Committee, [9525-2] S1, [9525-21] S4, [9527-11] S3  
Kozma, Peter [9526-27] S7, [9529-31] S7  
**Kraszewski, Maciej** [9525-12] S3, [9525-150] SPS, [9525-152] SPS, [9526-20] S5  
Krausewitz, Philipp [9529-3] S1  
**Krauter, Johann** [9529-38] S9  
**Krauze, Wojciech** [9526-35] S8  
Krekel, Christoph [9527-27] S6  
**Ku, Yi-Sha** [9525-46] SPS  
**Kuehnhold, Peter** [9525-25] S5, [9525-84] SPS  
Kühmstedt, Peter [9525-37] S8, [9525-40] S8, [9526-4] S2, [9528-12] S2, [9528-13] S2  
Kuhn, Michael [9526-17] S4  
Kuijk, Maarten [9528-31] S7, [9530-15] S4  
**Kujawinska, Malgorzata** [9525-58] S12, [9526-35] S8  
Kumar, Nitish [9526-27] S7  
**Kumar, Santosh** [9525-80] SPS, [9529-49] SPS

**Kumari, Anamika** [9529-49] SPS  
**Kuptsov, Vladimir D. D.** [9525-92] SPS  
**Kurihara, Toru** [9525-43] S9  
Kuschmierz, Robert [9525-66] S13

L  
Lachat, Elise [9528-16] S4  
Lages Martins, Luis F. [9525-82] SPS  
Lahamy, Hervé D. [9528-32] S7  
Lamberti, Luciano [9529-43] S10  
Lamouche, Guy [9525-13] S3  
Lan, Yung Sung [9528-41] SPS  
Lancis, Jesús Saez [9529-28] S7  
Landes, Tania [9528-16] S4  
Landwerth, Shirin [9529-26] S6  
Längle, Thomas [9525-33] S7, 9530 Program Committee  
Larichev, Roman A. [9525-129] SPS  
Larsson, Henrik [9526-13] S3  
Lasagni, Andres F. [9525-142] SPS  
**Lashmanov, Oleg U.** [9525-101] SPS, [9525-99] SPS, [9526-49] SPS  
Lasser, Theo 9529 Program Committee  
Latifi, Masoud [9525-134] SPS  
**Latour, Gaël** [9527-9] S6, [9529-34] S8  
Latyev, Svjatoslav M. [9525-110] SPS  
**Lazar, Josef** [9525-164] SPS, [9525-165] SPS, [9525-166] SPS, [9525-167] SPS  
Lazarenko, Vasiliy P. [9530-20] SPS  
Le Goic, Gaëtan [9525-75] S15  
Lebedinsky, Jeremy [9525-117] SPS, [9525-141] SPS  
Lebedko, Evgeni G. [9525-115] SPS, [9525-123] SPS, [9530-22] SPS  
**Leger, James R.** [9526-24] S6  
Lehmann, Peter 9525 Conference Chair, 9525 S1 Session Chair, 9525 S3 Session Chair, [9525-25] S5, [9525-84] SPS  
Lehnen, Stephan [9526-33] S8  
Lei, Li Hua [9525-86] SPS, [9525-88] SPS  
**Lei, Zhihui** [9528-35] SPS, [9530-1] S1  
Leick, Lasse [9525-8] S2  
Leissner, Johanna [9527-28] S6  
Lenz, Philipp [9529-3] S1  
Leo, Marco [9525-20] S4  
Leong-Hoi, Audrey [9528-11] S2  
Lepore, Alessia [9529-23] S6  
**Lešundák, Adam** [9525-164] SPS  
Levin, Alexander [9526-22] S5  
Li, Da-Hai [9525-32] S6  
Li, Haifeng [9530-7] S2  
**Li, Lifeng** [9526-1] S1, [9526-54] SPS  
**Li, Mengyang** [9525-32] S6  
Li, Min [9525-16] S3  
Li, Renpu [9525-143] SPS  
**Li, Weiqi** [9526-43] S10, [9526-45] S10  
Li, Yinan [9525-26] S5  
**Liang, Haida** 9527 Program Committee, 9527 S6 Session Chair, [9527-16] S4, [9527-5] S2  
Licchelli, Maurizio [9527-18] S4  
Lichti, Derek D. 9528 Program Committee, [9528-32] S7, [9528-9] S3  
Lin, Di [9526-24] S6  
Lin, Li-Chien [9526-6] S2

**Lindlere, Norbert** [9525-29] S6  
Liu, Huan [9525-73] S14  
Liu, Jinbo [9528-33] SPS  
Liu, Ping [9527-8] S2  
Liu, Qian [9525-10] S2  
Liu, Shijie [9525-109] SPS, [9525-111] SPS  
Liu, Songlin [9525-116] SPS  
Liu, Wenjin [9530-21] SPS  
Liu, Xiao Lin [9530-1] S1  
**Liu, Xiaolin** [9528-43] SPS  
**Liu, Xu** [9530-7] S2  
Liu, Yan [9528-43] SPS  
Liu, Yong [9525-100] S9  
Liu, Yongjun [9525-112] SPS  
**Liu, Ziji** [9529-27] S7  
Lizana, Angel [9526-46] S10, [9526-47] S10  
**Loew, Murray H.** [9527-15] S4  
Löffler, Frank [9525-66] S13  
Lohner, Tivadar [9526-27] S7  
Lomax, Suzanne [9527-15] S4  
Lombardi, Luca [9527-18] S4  
Long, Xingwu [9525-79] SPS, [9525-89] SPS  
López, Fernando [9527-17] S4  
**Lubashevsky, Ruth** [9527-31] SPS  
Lucian, Andrei [9527-16] S4  
Luhmann, Thomas 9528 Program Committee, 9528 S5 Session Chair, [9528-24] S6  
Lutzke, Peter [9525-40] S8

M  
Ma, Chenguang [9529-27] S7  
Ma, Dongmei [9525-56] S11  
Ma, Hong-qiang [9530-5] S1  
Ma, Hua [9525-100] S9  
**Ma, Kang** [9525-61] S12  
Ma, Long [9525-86] SPS, [9525-88] SPS  
Maas, Hans-Gerd 9528 Program Committee  
MacDonald, Lindsay William [9527-6] S2, [9528-17] S4, [9528-18] S4  
Macher, Hélène [9528-16] S4  
MacKinnon, David K. [9528-28] S7  
Madanipour, Khosro [9525-130] SPS, [9525-132] SPS, [9525-134] SPS, [9525-148] SPS, [9526-26] SPS, [9529-32] SPS, [9529-54] SPS  
Magalhães, Wagner Vidal [9527-29] SPS  
**Mahajan, Swapnil** [9525-122] SPS, [9525-139] SPS, [9529-57] SPS  
Mahmoud, Dalia N. [9528-36] SPS  
Maillard, Philippe [9525-65] S13  
Major, Csaba [9525-64] S13, [9526-27] S7, [9529-31] S7  
Makowski, Piotr L. [9526-35] S8  
Malagodi, Marco [9527-18] S4  
Maldague, Xavier P. V. [9527-17] S4  
Malek, Mokrane [9525-7] S2  
Malesa, Marcin [9525-58] S12  
Malin, Ivan K. [9530-25] SPS  
Mallat, Kamel [9525-11] S2  
Malygin, Alexander S. [9529-50] SPS, [9529-51] SPS  
Managò, Stefano [9529-40] S10, [9529-41] S10  
Mann, Guillermo [9530-23] SPS  
Manske, Eberhard 9525 Program Committee  
Mantel, Klaus [9525-29] S6  
**Maraev, Anton A.** [9525-155] SPS  
Marchesano, Valentina [9529-16] S4

# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

- Marchi, Gabriele [9529-45] S11  
Marczak, Jan A. [9527-34] SPS  
**Maria, Michael** [9525-8] S2  
Mariotti, Paola Iliaria [9527-19] S5, [9527-36] SPS  
**Markiewicz, Jakub Stefan** [9527-33] SPS, [9528-5] S1  
**Márquez, Andrés** [9526-47] S10  
Marquezin, Cassia A. [9529-9] S3  
**Marshall, Richard J.** [9526-34] S8, [9528-42] S1  
Martínez, José Luis [9526-47] S10  
**Martínez-Carranza, Juan** [9525-2] S1  
Martínez-León, Luis [9529-28] S7  
**Martins Costa, Manuel Filipe P. C. M.** [9527-29] SPS  
Martos-Leviv, Dominique [9527-21] S5, [9527-22] S5  
**Maruev, Ivan A.** [9530-22] SPS  
Masajada, Jan [9526-58] SPS  
Masiero, Andrea [9527-35] SPS  
Masini, Nicola 9527 Program Committee  
**Matsak, Ivan** [9526-18] S4  
Matthias, Steffen [9525-38] S8  
Maurer, Markus 9530 Program Committee  
Mavili, Gurcan [9527-2] S1  
Mayer, Konrad J. [9525-67] S13  
Mayershofer, Daniel [9525-81] S15  
Mazzeo, Pier L. [9530-27] SPS  
Meah, Chris J. [9526-34] S8, [9528-42] S1  
Meguellati, Saïd [9525-90] SPS  
Melis, Marcello [9527-21] S5  
Memmolo, Pasquale 9525 S2 Session Chair, [9525-18] S4, [9525-20] S4, [9529-19] S5, [9529-24] S6, [9529-29] S7, [9529-6] S3, [9529-7] S3  
**Mendoza Santoyo, Fernando** 9529 Program Committee  
Meneses Fonseca, Jaime Enrique [9525-157] SPS, [9525-158] SPS, [9525-161] S9  
Meng, Lichun [9528-13] S2  
Menna, Fabio [9528-17] S4, [9528-20] S5  
Merola, Francesco [9529-19] S5, [9529-24] S6, [9529-29] S7, [9529-6] S3, [9529-7] S3  
Metschke, Stephan [9525-66] S13  
Miccio, Lisa 9529 Program Committee, [9529-12] S2, [9529-19] S5, [9529-24] S6, [9529-29] S7, [9529-6] S3, [9529-7] S3  
Miccoli, Matteo [9527-21] S5  
Micó, Vicente [9525-137] SPS, [9525-140] SPS, [9529-13] S2, [9529-14] S2, [9529-55] SPS  
**Mikel, Bretislav** [9525-164] SPS, [9525-165] SPS, [9525-167] SPS  
Mikhailova, Julia [9529-50] SPS, [9529-51] SPS  
Mikheev, Sergey V. [9525-145] SPS  
Mikš, Antonín [9525-87] SPS  
Mills, Jon P. 9528 Program Committee  
Min, Guo [9525-73] S14  
Minoshima, Kaoru 9525 Program Committee, [9525-1] S1  
Mirabelli, Peppino [9529-40] S10  
Miura, Hiroyuki [9528-39] SPS  
Moalla, Rahma [9525-7] S2  
Mocellin, Marcomattia [9525-60] S12  
**Moiseeva, Anastasia A.** [9525-91] SPS  
Molev, Fedor V. [9525-101] SPS, [9526-52] SPS  
Mollabashi, Mahmoud [9525-132] SPS, [9529-54] SPS  
Molsen, Henning [9525-135] S1  
Mompert, Jordi [9526-46] S10  
Monneret, Serge 9529 Program Committee  
Montgomery, Paul C. [9525-34] S7, [9528-11] S2  
**Montonen, Risto** [9525-126] SPS  
Moore, Andrew J. Symposium Chair, 9525 Program Committee  
**Mora-González, Miguel** [9526-39] S9  
Moravvej, Mohammad [9528-32] S7  
Mordwinzew, Waldemar [9528-8] S3  
**Moreno, Ignacio** [9526-47] S10  
Mori, Yutaka [9529-28] S7  
**Mortensen, N. Asger** [9526-102] SJS  
Mouhoubi, Kamel [9527-22] S5  
Mroccka, Janusz [9526-53] SPS, [9526-59] SPS  
**Mu, Tingkui** [9525-100] S9  
Mues, Sarah [9529-8] S3  
Mugnano, Martina [9529-12] S2, [9529-19] S5, [9529-24] S6  
Munkelt, Christoph [9525-37] S8  
**Muñoz-Maciel, Jesús** [9526-39] S9  
Muñoz-Martínez, Juan F. [9529-25] S6  
**Murr, Patrik Johannes** [9525-63] S13  
Muzychenko, Yana B. [9526-60] SPS
- N**
- Nador, Judit [9526-27] S7, [9529-31] S7  
Nakajima, Yoshiaki [9525-1] S1  
**Naletto, Giampiero** [9528-26] S6  
Nasyrov, Ruslan K. [9525-55] S11  
Navello, Lorris [9525-117] SPS, [9525-141] SPS  
Navia, Juan David [9526-64] SPS  
**Nekrylov, Ivan S.** [9525-127] SPS, [9525-128] SPS  
Nelsen, Bryan [9525-14] S3  
Nercissian, Vanusch [9525-29] S6  
Netti, Paolo Antonio [9525-18] S4, 9529 Program Committee, [9529-19] S5, [9529-20] S5, [9529-24] S6, [9529-44] S11, [9529-6] S3, [9529-7] S3  
Neumann, Florian [9530-9] S3  
Neutov, Mikhail Y. [9526-62] SPS  
Nie, Xiaoming [9525-89] SPS  
**Nikulin, Anton V.** [9525-127] SPS, [9525-128] SPS, [9530-22] SPS  
Niskanen, Ilpo O. [9525-119] SPS  
Nitta, Christian [9525-67] S13  
Niu, Yi Fan [9525-86] SPS, [9525-88] SPS  
Noack, Kristina [9529-42] S10  
Nocerino, Erica [9528-17] S4, [9528-20] S5  
Noell, Wilfried [9525-49] S10  
Nolvi, Anton [9525-84] SPS  
Notni, Gunther Symposium Chair, 9525 Program Committee, 9525 S9 Session Chair, [9525-124] SPS, [9525-125] SPS, [9525-40] S8, [9526-4] S2, [9528-12] S2, [9528-13] S2  
**Novák, Jirí** [9525-87] SPS  
**Novák, Pavel** [9525-87] SPS  
Novoselova, Irina A. [9529-50] SPS, [9529-51] SPS  
Nowak, Tomasz [9527-13] S3
- O**
- Offret, Julien Pierre [9525-117] SPS, [9525-141] SPS  
Olivero, Massimo [9525-168] SPS  
Olszewska-Świątlik, Justyna [9527-7] S2  
Omenetto, Fiorenzo Gabriele 9529 Program Committee  
Oreski, Gernot [9525-24] S5  
Orta, Renato [9525-168] SPS  
Ortega Clavero, Valentin [9525-160] SPS  
Ossig, Rainer [9529-8] S3  
**Osten, Wolfgang** Symposium Chair, 9525 Conference CoChair, 9525 S1 Session Chair, [9525-50] S10, [9525-74] S15, 9526 Program Committee, 9526 S9 Session Chair, [9526-36] S8, [9527-27] S6, [9529-38] S9, 9530 Program Committee, [9530-3] S1  
Österberg, Kenneth [9525-126] SPS  
Ostrowski, Mariusz [9526-59] SPS  
**Otani, Yukitoshi** 9525 Program Committee, [9525-9] S2  
Oujja, Mohamed [9527-1] S1, [9527-3] S1  
**Oulehla, Jindrich** [9525-166] SPS
- P**
- Paciello, Antonio [9529-24] S6  
Padilla, J. Moises [9528-14] S2  
**Padilla-Vivanco, Alfonso** [9525-147] SPS, [9525-153] SPS  
Paganoni, Anna Maria [9529-35] S8  
Pagliarulo, Vito [9529-20] S5  
Palmer, Michael [9527-25] S3  
Palomar, Teresa [9527-3] S1  
Paloušek, David [9525-41] S8, [9530-4] S1  
Pampaloni, Enrico M. [9527-36] SPS  
Pantyushin, Anton V. [9525-156] SPS, [9530-16] S4  
Pantyushina, Ekaterina N. [9530-24] SPS  
Papadaki, Alexandra I. [9528-7] S3  
Papadakis, Vassilis M. [9527-8] S2  
Parikesit, Gea O. [9527-14] S3  
Parisotto, Simone [9527-19] S5  
**Park, YongKeun** 9525 Program Committee, [9529-39] S9  
Passilly, Nicolas [9529-38] S9  
Paturzo, Melania [9525-18] S4, [9525-20] S4, [9529-16] S4, [9529-29] S7  
Paulus, Dietrich W. [9528-8] S3  
**Pavlenko, Nikita A.** [9530-12] S3  
Pavlov, Petr A. [9525-85] SPS  
Pawelko, Romain [9527-30] SPS  
Pedrini, Giancarlo [9527-27] S6  
**Peinado, Alba** [9526-46] S10, [9526-47] S10  
Pellegrino, Paolo [9525-168] SPS  
Peña-Lecona, Francisco G. [9526-39] S9  
Peng, HeKuo [9526-16] S4  
Pereira, Silvanía F. [9526-27] S7, [9526-3] S1  
Pérez-Ortega, Sergio [9527-1] S1  
**Perrin, Stephane** [9529-38] S9  
Perrone, Guido [9525-168] SPS  
Persephonis, Peter [9529-59] SPS  
Perucho, Beatriz [9529-55] SPS
- Petrik, Peter** [9525-64] S13, 9526 S10 Session Chair, [9526-27] S7, [9529-31] S7  
Petrochenko, Andrey V. [9526-55] SPS  
**Petrov, Nikolay V.** [9525-106] SPS, [9525-138] SPS, [9529-15] S4  
Petsa, Elli [9528-25] S6, [9528-27] S6  
Pettazzi, Federico [9526-23] S5  
Pézerat, Charles [9525-69] S14  
Pezzati, Luca 9527 Conference Chair  
Pfeifer, Norbert 9528 Program Committee  
Pfeiffer, Pierre [9525-121] SPS  
**Pham, Tuan Minh** [9525-167] SPS  
**Phillips, Zachary Fitzgerald** [9529-27] S7  
**Picart, Pascal** 9525 Program Committee, 9525 S4 Session Chair, [9525-69] S14, [9525-7] S2  
Picazo-Bueno, Jose Angel [9525-140] SPS, [9529-14] S2, [9529-55] SPS  
Piccolo, Marcello [9527-26] S6  
**Pifferi, Antonio** [9529-35] S8  
Pillet, Maurice [9525-75] S15  
Pina, Vincent [9525-141] SPS  
Pirotti, Francesco [9527-35] SPS  
**Pitard, Gilles** [9525-75] S15  
Plachta, Kamil [9526-53] SPS  
Płócienniczak, Lukasz [9526-58] SPS  
Plucinski, Jerzy [9526-20] S5  
**Podoleanu, Adrian G. H.** [9525-8] S2  
Poittevin, Julien [9525-69] S14  
Pokorný, Petr [9525-87] SPS  
Poleshchuk, Alexander Grigorievich [9525-55] S11  
Poletto, Luca [9525-60] S12  
**Popescu, Gabriel** 9529 S9 Session Chair, [9529-5] S1  
**Popielek-Masajada, Agnieszka** [9526-58] SPS  
**Pourvais, Yousef** [9525-151] SPS  
Prajapati, Mahendrakumar P. [9525-122] SPS  
**Pravdová, Lenka** [9525-164] SPS  
Prein, Carina [9529-45] S11  
Preißler, Marc [9525-125] SPS  
Provaznik, Milan [9525-166] SPS  
Pruss, Christof 9525 S10 Session Chair, 9525 S11 Session Chair, [9525-50] S10, 9526 S2 Session Chair, [9530-3] S1  
**Psaltis, Demetri** 9529 S2 Session Chair, [9529-17] S4  
Puente León, Fernando 9530 Conference Chair, 9530 S2 Session Chair, 9530 S4 Session Chair, [9530-10] S3, [9530-23] SPS, [9530-9] S3
- Q**
- Qi, Te [9526-41] S9  
Qi, Xiaojuan [9528-32] S7  
Quarto, Giovanna [9529-35] S8  
Quintanilha, Richard 9526 S7 Session Chair  
Quinten, Michael [9526-25] S6
- R**
- Radis, Michela [9527-20] S5, [9527-24] S5  
Raffaelli, M. [9527-36] SPS  
Raghuwanshi, Sanjeev Kumar [9529-49] SPS



# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

- Ramírez, Claudio N.** [9526-38] S9, [9526-47] S10  
Ramirez-Barat, Blanca [9527-3] S1  
Ramm, Roland [9528-13] S2  
Raskar, Ramesh Meeting VIP  
Rathsfeld, Andreas 9526 Program Committee  
Razdan, Vikram [9530-13] S4  
Razi, Sepheer [9525-132] SPS, [9529-54] SPS  
Re, Cristina [9528-26] S6  
**Reardon, Patrick J.** [9525-54] S11  
**Rebordão, José Manuel N. V.** [9525-82] SPS  
Reetz, Edgar [9525-124] SPS  
Reghelin, Carlo [9527-12] S3, [9527-36] SPS  
Regio, P. [9525-168] SPS  
Reina, John H. [9526-64] SPS  
Reiners, Ansgar [9526-19] S4  
Reinhold, Stefan [9528-19] S5  
**Reithmeier, Eduard** 9525 Program Committee, [9525-26] S5, [9525-38] S8  
Rembe, Christian 9525 Program Committee  
Remondino, Fabio 9528 Conference Chair, 9528 S1 Session Chair, 9528 S7 Session Chair, [9528-17] S4, [9528-20] S5  
Ren, Huan [9525-100] S9, [9525-144] SPS  
**Reñucha, Šimon** [9525-164] SPS, [9525-167] SPS  
Rianna, Carmela [9529-20] S5  
Ribeiro, Álvaro S. [9525-82] SPS  
Richters, Jan-Peter P. [9525-48] S10  
Riesenberg, Rainer [9529-37] S9  
Rinner, Stefan J. [9525-35] S15  
Ritsch-Marte, Monika 9529 Conference Chair  
Robinet, Laurianne [9527-9] S6  
**Robinson, Alex P. G.** [9528-42] S1  
Robson, Stuart 9528 Program Committee, 9528 S6 Session Chair, [9528-15] S4, [9528-17] S4, [9528-18] S4  
Rodrigues, Joel J. P. C. [9525-131] SPS, [9525-162] SPS, [9530-24] SPS  
Rodríguez, Brian J. [9529-22] S5  
Romero, Jordi [9525-81] S15  
Rommel, Christina E. [9529-11] S2  
Roncella, Riccardo [9528-26] S6  
Rossi, Domenico [9529-7] S3  
Rossi, Giuseppe [9527-24] S5  
Roths, Johannes [9529-45] S11  
Rouba, Bogumila J. [9527-7] S2  
Rovetta, Tommaso [9527-18] S4  
**Royo, Santiago** [9525-70] S14, [9529-46] S11  
Rudek, Florian [9525-14] S3  
Ruiz, Pablo D. 9529 Program Committee  
Ryabukho, Vladimir P. [9529-48] SPS, [9529-52] SPS
- S**
- Saglimbeni, Filippo [9529-23] S6  
Sakhariyanova, Aiganym [9526-15] S4  
Salazar-Blaise, Félix 9530 Program Committee  
Salemi, Giuseppe [9528-26] S6  
Salimi Meidanshahi, Fatemeh [9525-148] SPS  
Salzenstein, Fabien [9525-34] S7  
Samper, Serge [9525-75] S15
- Sampson, David D.** 9529 Program Committee  
Samsonov, Alexander M. [9525-138] SPS  
Sanz, Martin [9525-140] SPS, [9529-14] S2  
Sanz, Mikel [9527-1] S1  
Sargeant, Ben [9528-17] S4  
Sarma, Sanjay E. [9525-154] SPS  
Sarżyński, Antoni [9527-34] SPS  
Saunders, David R. 9527 Program Committee  
Schaal, Frederik [9530-3] S1  
Schanne-Klein, Marie-Claire [9527-9] S6, [9529-34] S8  
**Schardt, Michael** [9525-63] S13  
Schau, Philipp [9526-36] S8  
Schellhorn, Mathias [9525-125] SPS  
**Scheruebl, Thomas** 9526 Program Committee  
Schivone, Patrick 9526 Program Committee  
Schindler, Johannes [9525-50] S10  
Schmidt, Frank [9526-28] S7  
Schmidt, Ingo [9528-13] S2  
Schmitt, Robert 9525 Program Committee, 9530 Program Committee  
Schnekenburger, Jürgen [9529-1] S1, [9529-11] S2, [9529-8] S3  
Schott, Robert [9525-39] S8  
Schrey, Olaf M. [9525-67] S13  
Schröder, Werner W. [9525-160] SPS  
Schuhmann, Rainer [9525-48] S10  
Schulz, Michael [9525-51] S11, 9526 S6 Session Chair  
Schurig, Florian [9525-52] S11  
Schweikard, Achim [9529-47] S11  
Schweitzer, Hagen [9526-17] S4  
Scott, Keana [9525-4] S1  
Sedlár, Petr [9525-166] SPS  
Seewig, Jörg 9525 S6 Session Chair, [9525-163] S7  
Seidel, Frank [9525-37] S8  
Seitz, Peter C. [9528-10] S2  
**Semenova, Irina V.** [9525-138] SPS, [9529-15] S4  
Seo, Yong Bum [9525-6] S2  
Serafetinides, Alexander-Panagiotis A. [9529-59] SPS  
Sereni, Barbara [9527-26] S6  
**Serikova, Mariya G.** [9525-131] SPS, [9525-156] SPS, [9525-162] SPS, [9530-16] S4, [9530-24] SPS  
**Serio, Bruno** [9525-117] SPS, [9525-121] SPS, [9525-141] SPS, [9527-30] SPS, [9528-11] S2  
**Serrano-García, David Ignacio** [9525-9] S2  
Serres, Nicolas [9525-34] S7  
Servin, Manuel [9528-14] S2  
Setija, Irwan D. 9526 Program Committee  
Sfarra, Stefano [9527-17] S4  
Shah, Prachi [9529-57] SPS  
Shahrabi Farahani, Shahrzad [9529-32] SPS  
Shahtahmassebi, Golnaz [9527-16] S4  
**Shaked, Natan Tzvi** 9529 Program Committee  
**Shakeri, S. Mojtaba** [9525-53] S11  
Shang, Yang [9530-1] S1  
**Shao, Jianda** [9525-109] SPS, [9525-111] SPS  
Shen, Biyao [9526-54] SPS
- Shevkunov, Igor A.** [9525-106] SPS  
Shi, Zhendong [9525-100] S9  
**Shinoda, Yukitaka** [9525-102] SPS  
Shmitkova, Ekaterina [9526-22] S5  
Shokri, Babak [9525-148] SPS  
Shortis, Mark R. 9528 Conference Chair, 9528 S3 Session Chair, 9528 S4 Session Chair  
Shyu, Deh-Ming [9525-5] SPS  
Sidyakin, Sergey [9530-19] SPS  
Sifter, David [9529-37] S9  
Silver, Richard M. 9526 Conference CoChair, [9526-30] S7  
Simioni, Emanuele E. S. [9528-26] S6  
**Singh, Gurdeep** [9525-80] SPS  
Sinzinger, Stefan [9525-52] S11  
Sirleto, Luigi [9529-41] S10  
Sironi, Laura [9529-9] S3  
Sitnik, Robert 9527 Program Committee  
Skakov, Pavel S. [9525-108] SPS, [9525-94] SPS  
Skamnitkaya, Lyubov S. [9530-11] SPS  
Skarlatos, Dimitrios P. [9528-23] S5  
Skorupski, Krzysztof [9526-21] S5, [9530-14] SPS  
Skrzeczanski, Wojciech [9527-34] SPS  
Smekhov, Andrey A. [9525-143] SPS, [9526-15] S4  
Smirnov, Nikolai V. [9525-110] SPS  
Soltwisch, Victor [9526-28] S7  
Sorg, Peter [9525-65] S13  
**Soskind, Michael G.** [9526-63] SPS  
**Soskind, Yakov G.** [9526-63] SPS  
**Sotnik, Alena** [9525-107] SPS  
Souza-Egipsy, Virginia [9527-1] S1  
Spagnolo, Paolo [9530-27] SPS  
Speranza, Mariela [9527-1] S1  
Spring, Marika [9527-5] S2  
Stallinga, Sjoerd [9525-53] S11  
Stavridis, Manuel [9525-51] S11  
Stege, Heike 9527 Program Committee  
Steinkopff, Albrecht [9529-45] S11  
Stentoumis, Christos [9528-25] S6, [9528-27] S6  
Steward, Jeremy [9528-32] S7  
Stifter, David 9529 Conference Chair  
**Stoppa, David** 9528 Program Committee  
Stork, Wilhelm [9526-14] S4, [9526-8] S2  
**Strakowska, Paulina** [9525-12] S3, [9525-150] SPS  
**Strakowski, Marcin R.** [9525-12] S3, [9525-150] SPS, [9525-152] SPS, [9526-20] S5  
Streck, Andreas [9526-8] S2  
Streeter, Lee [9528-29] S7  
Striova, Jana [9527-36] SPS  
**Stroner, Martin** [9525-93] SPS, [9528-34] SPS  
Strzelec, Marek [9527-34] SPS  
**Stüber, Patrick** [9529-47] S11  
Styles, Iain B. [9526-34] S8, [9528-42] S1  
Su, Bomin [9527-16] S4  
Su, Kai Leung [9525-103] SPS  
Su, Yonggang [9525-103] SPS  
Suckow, Anne [9525-65] S13  
Sun, Chen [9525-103] SPS  
Sun, Kuoyuan [9530-18] S4
- Sun, Weimin** [9525-112] SPS  
**Sun, Xiaoliang** [9528-43] SPS  
Sunarjo, Jonathan [9525-49] S10  
Sunday, Daniel F. [9525-5] SPS  
Sung, Hsin-Yueh [9528-41] SPS  
**Svensson, Thomas** [9526-13] S3  
Swirniak, Grzegorz [9526-51] SPS  
Sylwestrzak, Marcin [9527-7] S2  
**Szatkowski, Mateusz Michal** [9526-58] SPS
- T**
- Taghizadeh, Masoumeh [9525-134] SPS  
**Tajahuerce, Enrique** 9529 S11 Session Chair, [9529-28] S7  
Takami, Ayata [9525-120] SPS, [9529-53] SPS  
**Talaykova, Natalya A.** [9529-48] SPS  
Tan, Yi [9526-9] S2  
**Tang, Chen** [9525-103] SPS  
Taphanel, Miro [9525-33] S7  
Targowski, Piotr 9527 Conference Chair, [9527-7] S2  
**Taroni, Paola** [9529-35] S8  
**Tatam, Ralph P.** [9525-59] S12, [9525-72] S14  
Taudt, Christopher [9525-14] S3, [9525-142] SPS, [9525-24] S5  
Tereschenko, Stanislav [9525-25] S5, [9525-84] SPS  
Theska, René [9525-110] SPS  
**Thienpont, Hugo** 9529 S1 Session Chair, [9529-18] S5, 9530 Program Committee  
Tian, He [9525-112] SPS  
**Tian, Lei** [9529-27] S7  
Tiemann, Markus [9528-10] S2  
Tietz, Burkhard [9528-4] S1, [9528-8] S3  
Timofeev, Aleksandr N. [9525-101] SPS, [9525-127] SPS, [9525-128] SPS, [9525-155] SPS, [9525-156] SPS  
Timofeev, Andrey V. [9525-131] SPS, [9525-162] SPS  
**Tiziani, Hans J.** Meeting VIP  
Tokurakawa, Masaki [9527-5] S2  
Tolstoba, Nadezhda D. [9526-62] SPS  
Tornari, Vivi 9527 Program Committee, 9527 S5 Session Chair, [9527-22] S5, [9527-28] S6  
Tortiglione, Claudia 9529 Program Committee  
Toschi, Isabella [9528-17] S4  
Totzeck, Michael 9526 Program Committee  
**Toxqui-Quitl, Carina** [9525-147] SPS, [9525-153] SPS  
**Tremmel, Anton J.** [9525-63] S13  
Trichereau, B. [9527-22] S5  
Trifonov, Kirill V. [9525-115] SPS  
Trillo Yañez, Cristina 9525 Program Committee  
Trivedi, Vismay [9525-122] SPS, [9525-139] SPS, [9529-57] SPS  
**Trojanowski, Michal** [9525-12] S3, [9525-150] SPS, [9525-152] SPS, [9526-20] S5  
Tsigarida, Nota [9527-28] S6  
Tsigaridas, George N. [9529-59] SPS  
Tsyganok, Helen [9525-149] SPS  
Turgalieva, Tatiana V. [9525-146] SPS  
**Turola, Massimo** [9526-34] S8, [9528-42] S1



# INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

Turpin, Alejandro [9526-46] S10  
Turunen, Jari 9526 Program Committee  
Tusch, Jan [9525-39] S8  
Tutsch, Rainer 9525 Program Committee  
Twin, Andrew [9525-72] S14

## U

**Uguryol, Mehmet Fevzi** [9527-2] S1  
**Uhring, Wilfried** [9528-11] S2  
**Urbach, H. Paul** [9526-27] S7, [9526-3] S1  
**Urban, Rudolf** [9525-93] SPS, [9528-34] SPS

## V

Valente, Carmen [9529-40] S10  
Vallan, Alberto [9525-168] SPS  
Valyukhov, Vladimir P. [9525-92] SPS  
Vamvakousis, Vasilis [9528-23] S5  
van der Donck, Jacques C. J. [9526-23] S5  
van Vliet, Lucas J. [9525-53] S11  
Vannoni, Maurizio [9526-7] S2  
Vasilev, Aleksandr S. [9525-101] SPS, [9530-6] S2  
Vasyutinskii, Oleg S. [9529-15] S4  
Vater, Sebastian [9530-23] SPS  
Ventre, Maurizio [9529-20] S5  
Vernier, Paolo [9527-23] S5  
Veselova, Valeriya E. [9525-77] S15  
Vetrano, Maria Rosaria [9530-14] SPS  
**Vettore, Antonio** [9527-35] SPS  
Villafaña, Tana E. [9527-25] S3  
Villatoro, Joel [9525-71] S14  
**Viotti, Matias R.** 9525 S8 Session Chair, [9525-28] S6, [9525-30] S6  
**Vishnyakov, Boris V.** [9530-19] SPS, [9530-25] SPS  
Vizilter, Yury V. [9530-25] SPS  
Vlachos, Marinos [9528-23] S5  
Vladimirov, Alexander P. [9525-77] S15, [9529-33] S8, [9529-50] SPS, [9529-51] SPS  
**Völkel, Reinhard** [9525-49] S10  
Volkov, Mikhail V. [9528-37] SPS  
Volynsky, Maxim A. [9525-108] SPS, [9525-94] SPS  
von Freymann, Georg [9525-163] S7  
**Voznesenskaia, Mariia** [9525-56] S11  
Voznesenskaia, Tatiana [9525-56] S11  
Voznesenskaya, Anna [9529-58] SPS  
**Voznesenskiy, Nikolay B.** [9525-56] S11  
Vychodil, Miloslav [9525-166] SPS  
**Vygodov, Oleg V.** [9530-25] SPS

## W

**Wang, Ruikang K.** 9529 Program Committee  
Wang, Shuai [9526-40] S9, [9526-9] S2, [9530-21] SPS  
Wang, Wei [9525-104] SPS, [9525-118] SPS  
Wang, Wei [9530-5] S1  
Wang, Xingkai [9527-30] SPS  
Wang, Yang [9525-10] S2  
Wang, Yen-Chang [9528-41] SPS  
Wanner, Sven [9528-2] S1  
**Warren, Warren S.** [9527-25] S3  
**Watanabe, Eriko** 9525 Program Committee  
Weber, Andreas [9525-160] SPS  
Wei, Guo [9525-79] SPS  
Weidner, Frank [9525-55] S11  
**Weisbuch, Francois** [9530-2] S1  
Werling, Stefan 9530 Program Committee  
Wibbeling, Jana [9529-1] S1  
Wiedenmann, Ernst [9525-39] S8, 9530 Program Committee  
Wierzchos, Jacek [9527-1] S1  
Will, Stefan [9529-42] S10  
Willert, Volker 9530 Program Committee  
Wissel, Tobias [9529-47] S11  
Wolf, Andreas [9525-39] S8  
Wolfgramm, Florian [9525-48] S10  
Wu, Gaofeng [9525-114] SPS  
Wu, Guanhao [9525-1] S1  
**Wu, Hongyan** [9525-16] S3, [9526-16] S4  
Wu, Wen-li [9525-5] SPS  
**Wu, Xin** [9526-41] S9  
Wu, Yongqian [9525-114] SPS  
Wurm, Matthias [9526-28] S7, [9526-29] S7  
Wyrowski, Frank 9526 Program Committee, [9526-17] S4

## X

**Xie, Huimin** [9525-61] S12  
**Xing, Tingwen** [9526-57] SPS  
**Xu, Bing** [9526-40] S9, [9530-21] SPS  
Xu, Fuchao [9526-57] SPS  
**Xu, Haiyan** [9525-16] S3, [9526-16] S4  
Xu, Liang [9530-7] S2  
Xu, Xihong [9526-1] S1  
Xu, Yingjun [9525-73] S14

## Y

**Yokozeki, Shunsuke** [9525-31] S6  
Yoshimura, Michihiko [9525-43] S9  
Younes, Mohammad A. [9528-36] SPS  
Yu, Jie [9525-56] S11  
**Yu, Qifeng** [9528-35] SPS, [9528-43] SPS, [9530-1] S1  
Yu, Yingjie [9526-41] S9  
Yuan, Minglei [9525-104] SPS, [9525-118] SPS  
Yuan, Quan [9525-100] S9

## Z

Zakharov, Yuri N. [9529-30] S7  
Zalevsky, Zeev [9525-122] SPS, [9525-137] SPS, 9529 Program Committee, [9529-13] S2  
Zasada, Dariusz [9527-34] SPS  
**Zatocilová, Aneta** [9525-41] S8  
Zatorska, Anna [9527-34] SPS  
Zawieska, Dorota [9527-33] SPS, [9528-5] S1  
**Zeng, Lijiang** [9526-54] SPS  
**Zhang, Chen** [9525-32] S6  
Zhang, Chuanwei [9526-42] S10, [9526-43] S10, [9526-44] S10, [9526-45] S10  
Zhang, Chunmin [9525-105] SPS  
Zhang, Haitao [9525-56] S11  
Zhang, Hong Yan [9525-86] SPS, [9525-88] SPS  
Zhang, Jing-guo [9530-5] S1  
Zhang, Junjiang [9525-103] SPS  
**Zhang, Lin** [9525-100] S9  
Zhang, Linna [9526-41] S9  
Zhang, Nien-Fan [9526-30] S7  
Zhang, Shang-bin [9530-5] S1  
Zhang, Wenlong [9525-56] S11  
Zhang, Xiaohu [9528-35] SPS  
Zhang, Xuewu [9525-16] S3  
Zhang, Ye-hua [9530-5] S1  
Zhang, Yundong [9525-114] SPS  
Zhang, Zhuo [9525-16] S3  
Zhao, Chang [9525-104] SPS  
Zhao, Fulai [9530-18] S4  
Zhao, Yuanan [9525-109] SPS, [9525-111] SPS  
Zheltoy, Sergey Y. [9530-25] SPS  
Zheng, Xuejie [9526-47] S10  
Zhou, Hui [9526-30] S7  
Zhou, Jian [9525-89] SPS  
Zhou, You [9525-111] SPS  
Zhu, Y. [9526-3] S1  
Zinchik, Alexander A. [9526-60] SPS  
Zink, Ralf [9525-33] S7  
Zschiedrich, Lin [9526-28] S7  
**Zubia Zaballa, Joseba** [9525-71] S14  
Zuo, Chao [9525-83] SPS  
Zverev, Victor [9526-56] SPS  
Zvereva, Elena [9525-123] SPS  
Zyuzin, Vadim V. [9530-24] SPS

# GENERAL INFORMATION

## REGISTRATION

### Onsite Registration and Badge Pick-Up Hours

#### ICM Foyer West

Sunday 21 June 2015	10:00 to 17:00 hrs.
Monday 22 June 2015	7:30 to 17:00 hrs.
Tuesday 23 June 2015	8:00 to 17:00 hrs.
Wednesday 24 June 2015	8:30 to 17:00 hrs.
Thursday 25 June 2015	8:30 to 16:00 hrs.

### Conference Registration

Includes admission to all conference sessions, plenaries, panels, and poster sessions, admission to the World of Photonics Exhibition, Welcome Reception, coffee breaks, and a choice of proceedings. Student pricing does not include proceedings.

### Exhibition Registration

Exhibition-Only visitor registration is complimentary.

### SPIE Member, SPIE Student Member, and Student Pricing

- SPIE Members receive conference registration discounts. Discounts are applied at the time of registration.
- Student registration rates are available only to undergraduate and graduate students who are enrolled full time and have not yet received their Ph.D. Post-docs may not register as students. A student ID number or proof of student status is required with your registration.

### Press Registration

For credentialed press and media representatives only. Please email contact information, title, and organization to [media@spie.org](mailto:media@spie.org).

### SPIE Cashier

#### ICM Foyer West

Open during registration hours

### Registration Payments

- If you are paying by cash or cheque as part of your onsite registration, wish to add a course, workshop, or special event requiring payment, or have questions regarding your registration, visit the SPIE Cashier.

### Receipts and Certificate of Attendance

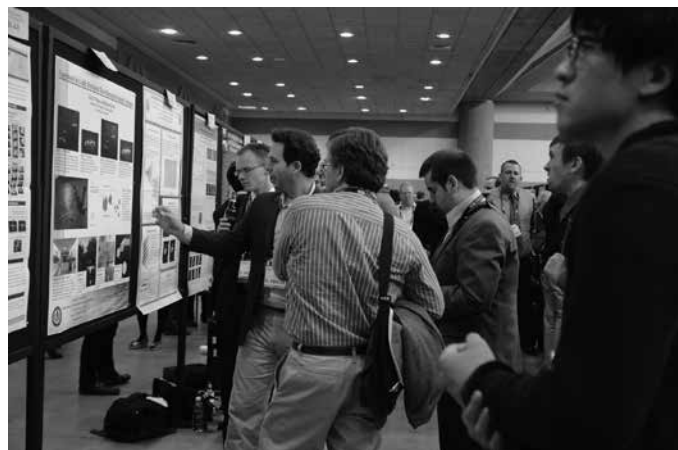
- Preregistered attendees who did not receive a receipt or attendees who need a Certificate of Attendance may obtain those from the SPIE Cashier.

### Badge Corrections

- Badge corrections can be made by the SPIE Cashier. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

### Refund Information

There is a €40 service charge for processing refunds. Requests for refunds must be received by 10 June 2015; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions or Special Events purchased are not refundable.



## AUTHOR/PRESENTER INFORMATION

### Speaker Check-In and Preview Station

#### ICM Foyer

Monday through Thursday . . . . . Open during registration hours

All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are asked to upload their presentations in Hall B0, where M-Events will be available to help with any questions during registration hours.

### Poster Set-up Instructions

#### ICM Foyer

Tuesday 23 June 2015 . . . . . 17:30 to 19:00  
(Conference 9525, 9526, 9528, 9529, 9530)

Wednesday 24 June . . . . . 11:30 to 12:30  
(O3A Conference, 9527)

All symposium attendees are invited to attend the Tuesday poster session provided as an opportunity to enjoy networking and refreshments while reviewing poster papers.

Poster presenters may post their poster papers starting at 10:00 on Tuesday in the Conference Area and present them during Tuesday and Wednesday Poster Sessions. Any papers left on the boards following 12:00 hrs on Thursday 25 June will be considered unwanted and will be discarded.

SPIE assumes no responsibility for posters left up after the end of the Poster Session. Poster authors should be at their papers on Monday and Wednesday to answer questions from attendees. For specific times, please see the individual conference programs. Attendees are requested to wear their conference registration badges to the poster sessions.

## FOOD AND BEVERAGE SERVICES

### Coffee Breaks

#### ICM Foyers / Novotel Foyer

Complimentary coffee will be served twice daily, in the Conference Foyer Areas at the times indicated in the programme. Please refer to the individual conference programmes for timings for coffee and lunch breaks.

### Food & Refreshments for Purchase

The ICM has three permanent food-service operations in the foyer area – the ICM Bistro, ICM Bar and ICM Café where guests can purchase food. There is also the “Am See” restaurant, located on the 1st floor above the registration area of the ICM. Lunch at the Novotel is also available to those who are not staying at the hotel.

There are also a number of bars and restaurants located in the “Riem Arkaden” shopping centre on the other side of the underground station for the ICM, “Messestadt West”.

## ONSITE SERVICES

### Internet Access

Complimentary Internet will be available. Connection speeds will depend on the number of users. Please read the SPIE Wireless Internet Service Policy.

### SPIE Conference App

Download the free SPIE Conference App, available for iPhone and Android phones. Search and browse the programme, special events, participants, exhibitors, and more.

### SPIE Luggage + Coat Check

#### Below the registration area in ICM West Entrance

Open during registration hours

Luggage, package, and coat storage are available against charge. Please note this service is only available during registration hours.

### Urgent Message Line

Messages for attendees can be left by calling +49 89 949 34024. Attendees should check the message board in the registration area for any messages held for them.

### The Business Centre

#### ICM Foyer

Open during registration hours.

Use this service to print your boarding pass at a charge.

## CAR RENTAL



Call the Hertz International Reservation Center at 1-800-654-3001 in the USA or your local Hertz Reservations Center to receive a special discount for SPIE. Reservations may also be placed on-line at

[www.hertz.com](http://www.hertz.com). You will receive 15% off qualifying Affordable rates at participating locations in Munich.

Be sure to identify yourself as a SPIE attendee. The PC#137480 must be on your advance reservation to receive this special offer. You must present this coupon at the time of rental in order to receive this discount. This special offer is available for rentals from June 15-30, 2015.

## TRAVEL

### About Munich

Munich, "the city with a heart," is the capital of Bavaria, and has established itself as Germany's high-tech hub (Silicon Bavaria) and is one of the most important industrial and economic centers in the European community. It boasts of such high-tech corporations as BMW and Daimler-Chrysler Aerospace. In addition to being the country's leading university center and hub for insurance, banking, electronic, and mechanical engineering, Munich offers its visitors shopping, music, art, gourmet restaurants, beer gardens, outdoor cafes, ethnic restaurants, popular night-spots, grand cathedrals, and opulent palaces. For more information on Munich and the surrounding area, please refer to the official website for the city of Munich.

### Cross-Country Bus Transport

National cross-country bus services have operated in Germany since 2013. For more information on routes and tariffs, visit [www.FlixBus.com](http://www.FlixBus.com).

### Shuttles, Public Transportation & How to reach the Internationales Congress Center Munich

At Munich Central Station take the underground U2. The journey to the trade fair grounds takes about 17 minutes. [http://www.messe-muenchen.de/en/meta/anreise/anreise\\_2\\_contentmaster.php](http://www.messe-muenchen.de/en/meta/anreise/anreise_2_contentmaster.php).

### Driving Directions and Parking

Visit World of Photonics 2015 "arriving by car" [http://www.messe-muenchen.de/en/meta/anreise/anreise\\_2\\_contentmaster.php](http://www.messe-muenchen.de/en/meta/anreise/anreise_2_contentmaster.php).



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The following Policies and Conditions apply to all SPIE Events. As a condition of registration, you will be required to acknowledge and accept the SPIE Registration Policies and Conditions contained herein.

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### Misconduct Policy

SPIE is a professional, not-for-profit society committed to providing valuable conference and exhibition experiences. SPIE is dedicated to equal opportunity and treatment for all its members and meeting attendees. Attendees are expected to be respectful to other attendees, SPIE staff, and contractors. Harassment and other misconduct will not be tolerated; violators will be asked to leave the event.

### Identification

To verify registered participants and provide a measure of security, SPIE will ask attendees to present a government-issued Photo ID at registration to collect registration materials.

Individuals are not allowed to pick up badges for attendees other than themselves. Further, attendees may not have some other person participate in their place at any conference-related activity. Such other individuals will be required to register on their own behalf to participate.

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By registering for an SPIE event, I grant full permission to SPIE to capture, store, use, and/or reproduce my image or likeness by any audio and/or visual recording technique (including electronic/digital photographs or videos), and create derivative works of these images and recordings in any SPIE media now known or later developed, for any legitimate SPIE marketing or promotional purpose.

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### Payment Method

Registrants for paid elements of the event, who do not provide a method of payment, will not be able to complete their registration. Individuals with incomplete registrations will not be able to attend the conference until payment has been made. SPIE accepts VISA, MasterCard, American Express, Discover, Diner's Club, checks and wire transfers. Onsite registrations can also pay with Cash.

### Authors/Coauthors

By submitting an abstract, you agree to the following conditions:

- An author or coauthor (including keynote, invited, and solicited speakers) will register at the author registration rate, attend the meeting, and make the presentation as scheduled.
- A full-length manuscript (minimum 6 pages) for any accepted oral or poster presentation will be submitted for publication in the SPIE Digital Library, printed conference Proceedings, and CD. (Some SPIE events have other requirements that the author is made aware of at the time of submission.)
- Only papers presented at the conference and received according to publication guidelines and timelines will be published in the conference Proceedings and SPIE Digital Library (or via the requirements of that event).

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Conferences, courses, and poster sessions: For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter or instructor. Attendees may not capture or use the materials presented in any meeting/course room or in course notes on display without written permission. Consent forms are available at Speaker Check-In. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media.

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SPIE supplies tested and safety-approved laser pointers for all conference meeting rooms. For safety reasons, SPIE requests that presenters use provided laser pointers.

Use of a personal laser pointer represents user's acceptance of liability for use of a non-SPIE-supplied laser pointer. If you choose to use your own laser pointer, it must be tested to ensure <5 mW power output. Laser pointers in Class II and IIIa (<5mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. Come to Speaker Check-In and test your laser pointer on our power meter. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Misuse of any laser pointer can lead to eye damage.

## Access to Technical and Networking Events

Persons under the age of 18 including babies, carried or in strollers, and toddlers are not allowed in technical or networking events. Anyone 18 or older must register as an attendee. All technical and networking events require a valid conference badge for admission.

## Underage Persons on Exhibition Floor Policy

For safety and insurance reasons:

- No persons under the age of 18 will be allowed in the exhibition area during move-in and move-out.
- Children 14 and older, accompanied by an adult, will be allowed in the exhibition area during open exhibition hours only.
- All children younger than 14, including babies in strollers and toddlers, are not allowed in the exhibition area at any time.

## Unauthorized Solicitation Policy

Unauthorized solicitation in the Exhibition Hall is prohibited. Any non-exhibiting manufacturer or supplier observed to be distributing information or soliciting business in the aisles, or in another company's booth, will be asked to leave immediately.

## Unsecured Items Policy

Personal belongings should not be left unattended in meeting rooms or public areas. Unattended items are subject to removal by security. SPIE is not responsible for items left unattended.

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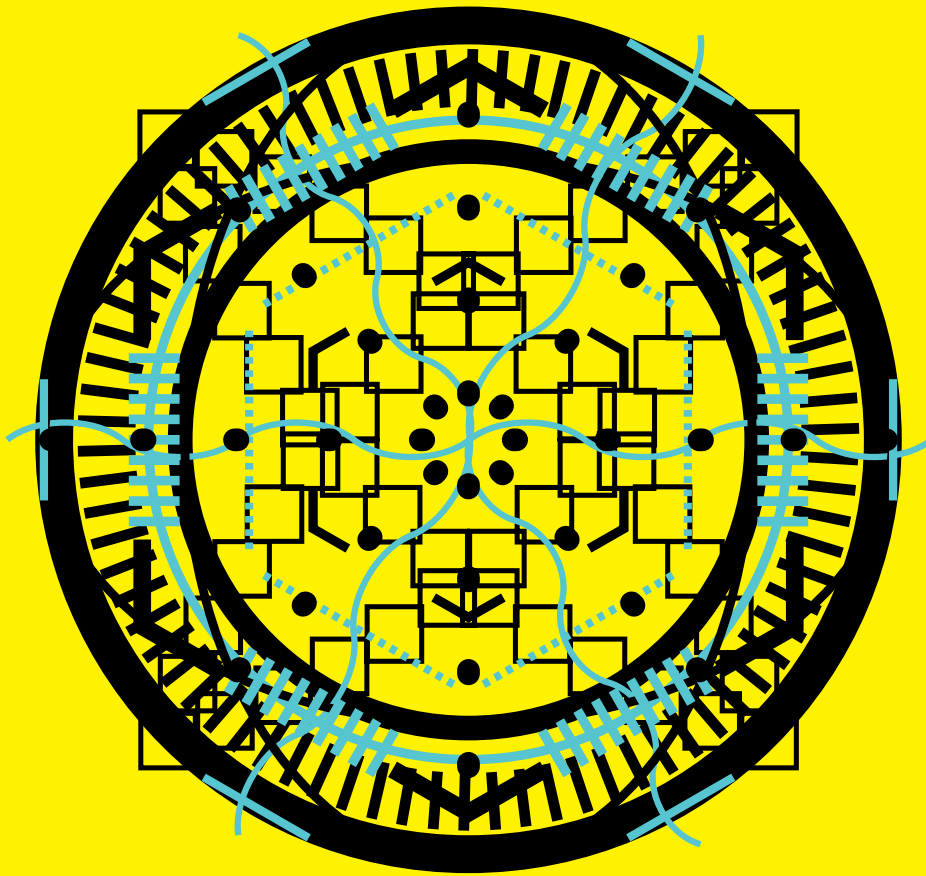
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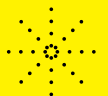
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