SPIE. OPTICAL METROLOGY

SPIE. DIGITAL OPTICAL TECHNOLOGIES

2017

OPTICAL METROLOGY

The latest research in measurement systems, modeling, videometrics, and inspection

DIGITAL OPTICAL TECHNOLOGIES

A new conference focused on the components, systems design, and applications of emerging digital optical technologies

Co-located Events

25–29 June 2017
Internationales Congress Center, Munich, Germany

23rd International Congress on Photonics in Europe
Collocated with LASER 2017 World of PHOTONICS

WORLD OF PHOTONICS CONGRESS

www.photonics-congress.com

WELCOME TO MUNICH

SPIE is pleased to offer two technical meetings and four new courses in Munich. We look forward to an exciting week of sharing, networking, and learning.

25–29 June 2017 · Internationales Congress Center, Munich, Germany

SPIE. OPTICAL METROLOGY

The premier European conference to meet with scientists, engineers, researchers, and product developers to discuss the latest research in measurement systems, modeling, videometrics, and inspection.

www.spie.org/om

Sponsored by:
SPIE.

Cooperating Organisations

EOS European Optical Society

WLT German Scientific Laser Society (Wissenschaftliche Gesellschaft Lasertechnik e.V.)

SPIE. DIGITAL OPTICAL TECHNOLOGIES

A new conference focused on the components, systems design, and applications of emerging digital optical technologies in all social, academic, medical, and industrial areas.

The conference reflects trends in recent technologies such as 3D sensors, immersive multimedia, novel displays, light sources and imaging systems. Digital optical technologies include optics designed by digital means, fabricated by digital means, with functionalities enhanced or altered by digital techniques (computational optics or dynamic optics).

www.spie.org/dot

MANAGED BY **SPIE.EUROPE**

SPIE Europe Ltd., a subsidiary of SPIE, is a not-for-profit UK-registered company serving SPIE constituents throughout Europe as an advocate and liaison to political and industry associations within the European optics and photonics community.

In addition to providing membership services, SPIE Europe Ltd. organises and manages internationally recognised conferences, education programmes, and technical exhibitions featuring emerging technologies in optics and photonics.

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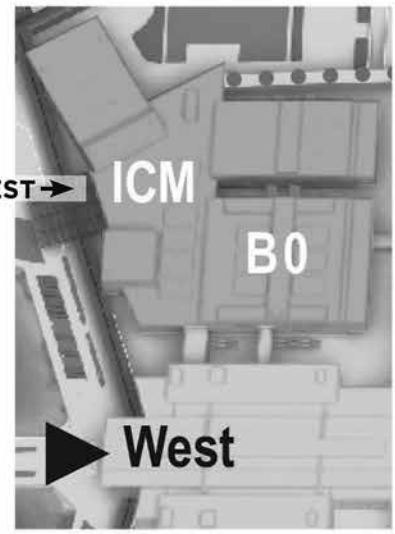
SPIE OPTICAL METROLOGY TECHNICAL CONFERENCES

SPIE DIGITAL OPTICAL TECHNOLOGIES TECHNICAL CONFERENCE

DON'T MISS the **Augmented Reality/Virtual Reality Hands-On Demo Sessions,** *p. 4*

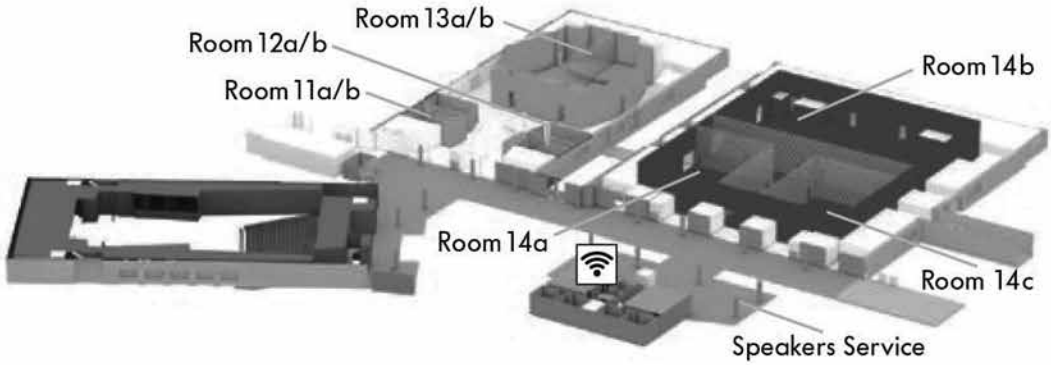
INTERNATIONALES CONGRESS CENTER
FLOOR PLANS

ROOMS AT THE ICM AND B0

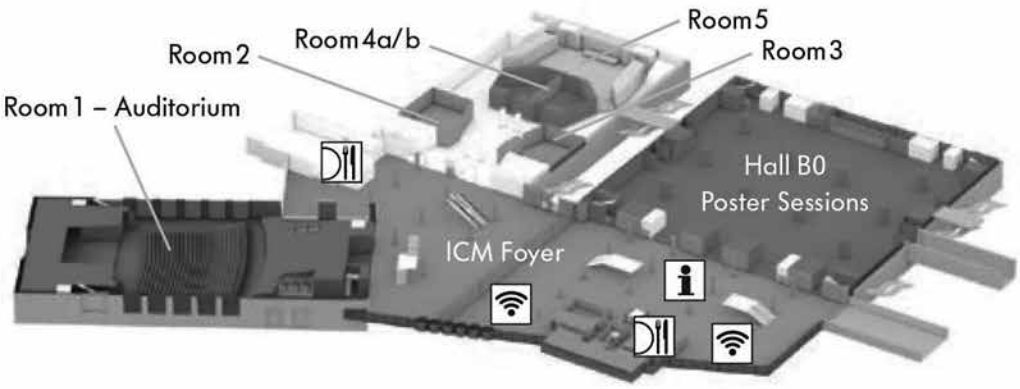


2nd FLOOR

1st FLOOR

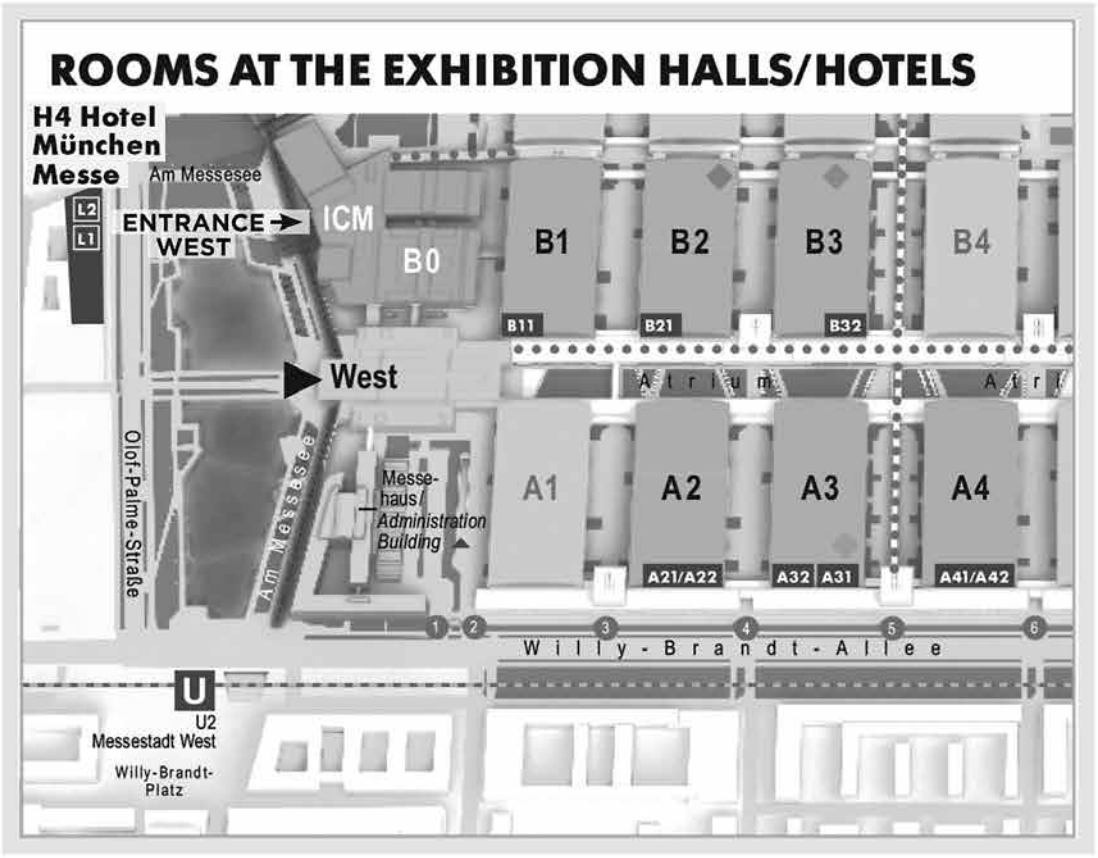


GROUND FLOOR



Wifi-Lounge Catering Information Desk

ROOMS AT THE EXHIBITION HALLS/HOTELS

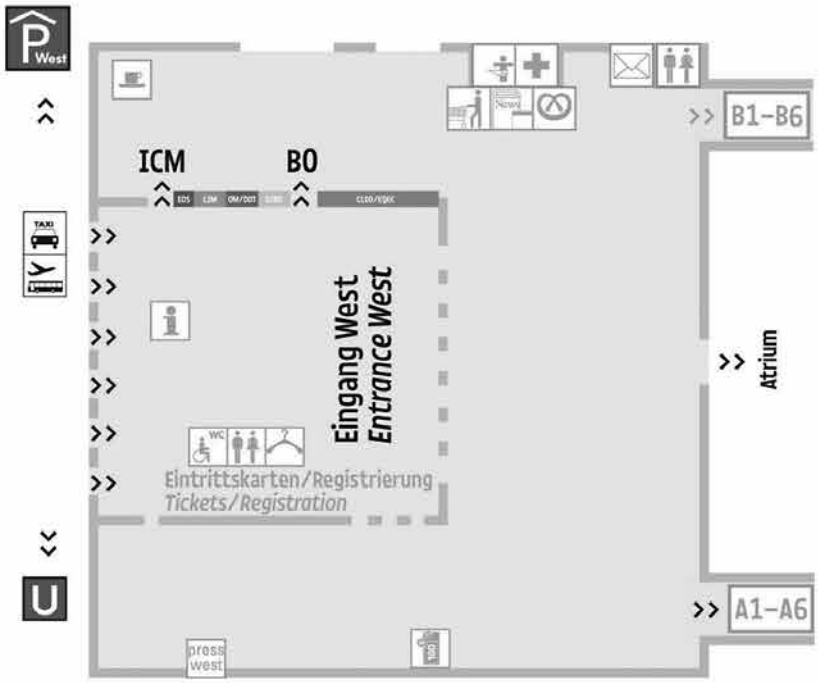


B11	Room **"Einstein",** 1st Floor, Hall B1
B21	Room **"Hertz",** 1st Floor, Hall B2
B32	Room **"Maiman",** 1st Floor, Hall B3
A21/A22	Room **"Edison",** 1st Floor, Hall A2
A32	Room **"Newton 2",** 1st Floor, Hall A3
A31	Room **"Newton 1",** 1st Floor, Hall A3
A41/A42	Room **"Röntgen",** 1st Floor, Hall A4
L1	H4 Hotel München Messe: Room **"Ludwig"**
L2	H4 Hotel München Messe: Room **"Leopold"**

Also visit our Forums:

- **A3** Photonics Forum Hall A3 "Industrial Laser Applications," Booth A3.450
- **B2** Photonics Forum Hall B2 "Biophotonics and Medical Applications / Optical Metrology and Imaging," Booth B2.560
- **B3** Photonics Forum Hall B3 "Lasers and Optics," Booth B3.360

ICM ENTRANCE WEST



DAILY EVENT SCHEDULE

Sunday 25 June	Monday 26 June	Tuesday 27 June	Wednesday 28 June	Thursday 29 June
CONFERENCES				
	OPTICAL METROLOGY			
	Conf. 10329: **Optical Measurement Systems for Industrial Inspection** *(Lehmann),* 11			
	Conf. 10330: **Modeling Aspects in Optical Metrology** *(Bodermann),* 18			
	Conf. 10332: **Videometrics, Range Imaging, and Applications** *(Remondino, Shortis),* 24		Conf. 10331: **Optics for Arts, Architecture, and Archaeology (O3A)** *(Pezzati, Targowski),* 22	
	Conf. 10333: **Optical Methods for Inspection, Characterization and Imaging of Biomaterials** *(Ferraro, Grilli, Ritsch-Marte, Hitzenberger)*, 26			Conf. 10334: **Automated Visual Inspection and Machine Vision** *(Beyerer, Puente León)*, 29
	DIGITAL OPTICAL TECHNOLOGIES			
	Conf. 10335 **Digital Optical Technologies** *(Kress, Osten, Uhrbach)*, 31			
SPECIAL EVENTS				
Workshop: **Making the Most of your Presentation** (Doumont) 8:30 to 12:30, p. 6	*Workshop:* **Conveying Messages with Graphs** (Doumont), 8:30 to 12:30, p. 6	**Hands-On Demo Session,** 10:00 to 16:00, p. 4	**Hands-On Demo Session,** 10:00 to 16:00, p. 4	**Poster Session III** (Conf. 10334), p. 5
Workshop: **Structuring your Research Paper** (Doumont) 13:30 to 17:30, p. 6	**World of Photonics Plenary Session** *(Wrachtrup),* 10:00 to 11:00, p. 3	**Poster Session I** (Conf. 10329, 10332), p. 5	**SPIE Plenary Session,** *(Capasso),* 10:40 to 11:25, p. 3	
	Students and SPIE Fellows Luncheon, 12:30 to 14:00, p. 5		**Poster Session II** (Conf. 10330, 10331, 10333), p. 5	
	Hands-On Demo Session, 14:00 to 16:00, p. 4		**Career Choices Panel Discussion,** 13:20 to 14:00, p. 5	
			Welcome Reception, 19:00 to 21:30, p. 5	
COURSES				
SC1216 **Using Spatial Light Modulators** *(Haist),* 8:30 to 12:30, p. 7				
SC1218 **Optical technologies and architectures for Virtual Reality (VR)...** *(Kress),* 8:30 to 12:30, p. 8				
SC1217 **Design, modeling and fabrication techniques for micro-optics...** *(Kress),* 13:30 to 17:30, p. 7				
SC1219 **Joint design of optics and image processing in computational sensing and imaging** *(Stork),* 13:30 to 17:30, p. 9				

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

Monday 26 June 2017 · 10:00 AM - 11:00 AM
Location: Saal 1, ICM

10:00 AM to 11:00 AM:

Putting a Spin on Photons

Jörg Wrachtrup
Univ. of Stuttgart (Germany)

Efficient matter photon interfaces are key ingredients of quantum technology. Quantum communication relies on photon storage and processing but spin photon interfaces can also increase the sensitivity of quantum sensors.

Biography: **Prof. Dr. Jörg Wrachtrup,** who is the head of the 3rd Institute of Physics at the University of Stuttgart, received the first ever Zeiss Research Award this year. He received the Gottfried Wilhelm Leibniz Award for his research work in 2011 and the Max Planck Research Award in 2014.

SPIE PLENARY SESSION

Wednesday 28 June 2017 · 10:30 AM - 11:25 AM
Location: Saal 1, ICM

10:30 to 10:40

Welcome and Introduction

10:40 to 11:25

Metasurface Diffractive Optics

Federico Capasso
John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., United States

Metasurfaces based on subwavelength patterning have major potential for arbitrary control of the wavefront of light by achieving local control of the phase, amplitude and polarization and allowing greater functionality and more compact devices. High performance metalenses for the visible, achromatic lenses, axicons, vortex plates, holograms, ultracompact spectrometers and polarimeters will be discussed along with the potential of this technology for a wide range of applications.

Biography: **Federico Capasso** is the Robert Wallace Professor of Applied Physics at Harvard University, which he joined in 2003 after 27 years at Bell Labs where his career advanced from postdoctoral fellow to Vice President for Physical Research. He pioneered bandstructure engineering of semiconductor heterostructures, including the invention of the quantum cascade laser; investigated Casimir forces using micromechanics and performed the first measurement of the repulsive Casimir force. Recent contributions include wavefront control using metasurfaces including the generalized laws of refraction and reflection and a new class of flat optical components such as high efficiency diffraction limited metalenses in the visible. He is the recipient of the 2016 Balzan prize for Applied Photonics. Other awards include the King Faisal Prize for Science, the IEEE Edison Medal, the American Physical Society Arthur Schawlow Prize, the SPIE Gold Medal, the Rumford Prize of the American Academy of Arts and Sciences, the Franklin Institute Wetherill Medal, the European Physical Society Quantum Electronics Prize, the Materials Research Society Medal, Jan Czochralski Award for lifetime achievement in Materials Science, the IEEE D. Sarnoff Award. He is a member of the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Sciences, the Academia Europaea and a foreign member of the Accademia dei Lincei; he holds honorary doctorates from Lund University, University Paris-Diderot and University of Bologna.

SPECIAL HANDS-ON AR/VR/MR DEMONSTRATION SESSIONS

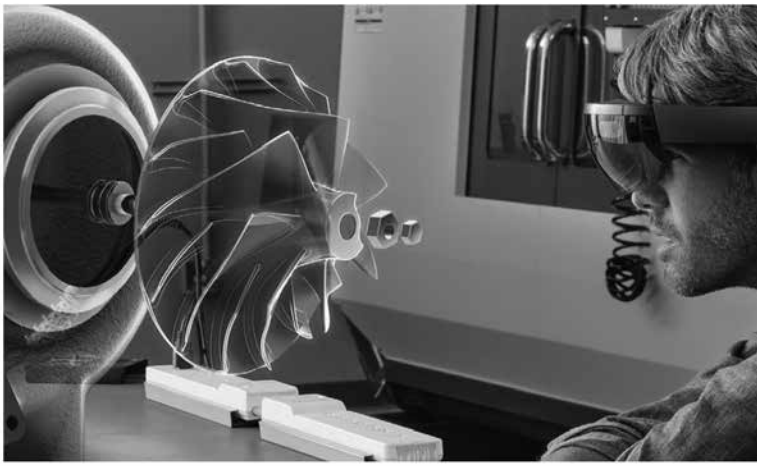
Augmented Reality / Virtual Reality / Mixed Reality Demo Sessions

Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) systems are poised to revolutionize the future; the way people communicate, learn and explore, be productive in their personal and professional lives, shop on-line, play and be entertained.

You have a chance to try out these systems for yourself. Participate in an interactive personal demo session that will allow you to try out some of the most advanced Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) headsets available today.

FOUR SYSTEMS TO CHOOSE FROM:

- **Microsoft HoloLens Mixed Reality Untethered Headset**
- **Oculus Rift CV1 VR Headset with Hand Controllers**
- **HTC Vive VR headset with Hand Controllers**
- **Sony PlayStation VR Headset with Hand Controllers**



DEMO TIMES

Monday 26 June · 14:00 to 16:00 hours
Tuesday 27 June · 10:00 to 16:00 hours
Wednesday 28 June · 10:00 to 16:00 hours

Four devices available; one device per session (please choose your device). All demos are personal 20-minute sessions and take place at H4 Hotel München Messe. If you want to try out multiple devices, please book multiple sessions.

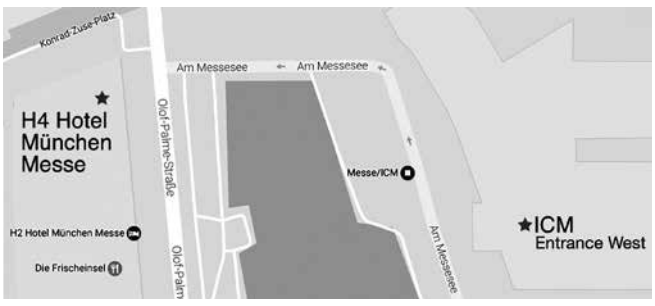
ADDITIONAL DEMOS

Parallel to the personal demos above, an additional open demo will show novel display technologies that one day might be implemented in HMDs or other consumer display products. Located in the same room before or after your allocated slot.

Tuesday 27 June
LIGHTSPACE3D 3D display technologies

Wednesday 28 June
HOLOEYE phase panel holographic display technologies

Demos take place at the **Hotel H4 München Messe, Room Ludwig**



COME EXPERIENCE NOVEL DISPLAY TECHNOLOGIES

Pre-registered for the demo? Information and time slots were sent via email. Go to the **H4 Hotel München Messe** at your allocated time slot.

Looking to register onsite? Go to the H4 Hotel München Messe.

Social and Networking Events

Students and SPIE Fellows Luncheon

Monday 26 June 2017 · 12:30 to 14:00

Location: Fairgrounds, Restaurant Seeblick

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

Student conference attendees 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 but students must sign up at the SPIE registration desk onsite.

Bier & Brezel Reception

Monday 26 June 2017 · 18:00 to 20:00

Location: Main Foyer, ICM and Hall B0

SPIE invites all attendees to a Bier & Brezel reception. All registered conference attendees are welcome; please remember to wear your conference registration badges. Dress is casual.

Optical Metrology and Digital Optical Technologies Joint Poster Sessions

Tuesday 27 June (Conf. 10329, 10332)

Wednesday 28 June (Conf. 10330, 10331, 10333, 10335)

Thursday 29 June (Conf. 10334)

Location: ICM Foyer

See conference programmes for specific timing.

All symposium attendees are invited to attend Optical Metrology and Digital Optical Technologies Poster Sessions held on Monday, Tuesday and Wednesday, and provided as an opportunity to enjoy networking while reviewing poster papers.

Poster presenters may post their poster papers starting at designated times for each conference and present them during their respective conference Poster Session. Any papers left on the boards following the designated removal time will be considered unwanted and will be discarded. (Please see page 36 for more details.)

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

Welcome Reception

Wednesday 28 June 2017 · 19:00 to 21:30

Location: Ratskeller am Marienplatz

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). Please wear your badge.

Student and Professional Development Events

Student Chapter Leadership Workshop

Saturday 24 June 2017 · 9:00 to 17:00

Location: Fairgrounds, Room B11 "Einstein"

Open to SPIE Student Chapter members

SPIE's successful Student Chapter Leadership Workshop is back in Europe!

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 persuade others, 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.

Jean-luc Doumont, Principiae

An engineer (Louvain) and PhD in applied physics (Stanford), Jean-luc is acclaimed worldwide for his no-nonsense approach and his highly applicable, often life-changing recommendations on a wide range of topics. During his workshops, he uses trees, maps, theorems, and other tools featured in his book about "effective communication for rational minds." He is also a popular visiting lecturer for SPIE and travels several times a year to speak to chapters around the world. For more information about Jean-luc, please visit www.principiae.be.

All SPIE student chapter members are welcome, but must register to attend. Please email students@spie.org to register, or for information.

Career Choices Panel Discussion

Wednesday 28 June 2017 · 13:20 to 14:00

Location: Exhibition Floor Forum, Hall A3

There are numerous critical career choices and decisions that face new graduates in optics and photonics. Academia or Industry? Staying in your current job, or making a career transition? This event will help you explore potential career pathways in the world of photonics and get solid advice on how you can translate your knowledge, abilities, and interests into meaningful work. Join our experienced panelists and have your questions answered in this wide-ranging discussion.

Moderator
Pamela Robertson
SPIE, Industry Relations

Panelists
Magnus Bengtsson
Vice President Strategic Marketing, Coherent

Nishant Mohan
Vice President OCT Division, Wasatch Photonics

Hagar Edelstain
Optical Engineer, HoloLens Microsoft

Gary Hayes
CEO/General Manager, Laser Components USA

WORKSHOPS

Aligning Education with Innovation Workshop

Wednesday 28 June 2017 · 14:00 to 18:00

Location: Fairgrounds, Room B12

Listen to and discuss with:
- Industry representatives
- Innovation experts from academia
- Representatives from EU educational programmes

About:
- What actions and measures are necessary to align education with innovation
- How can universities and industry better collaborate to trigger innovation

After the presentations:
- Networking with refreshments and snacks
- Matchmaking opportunity for job/internship seekers and companies!

Participation in the workshop is free of charge but you must register to attend. This workshop is organized in the framework of the EU Horizon 2020 project "RespiceSME" and the Photonics Public Private Partnership (Photonics21).

Making the Most of your Presentation

Sunday 25 June 2017 · 8:30 to 12:30

Location: Fairgrounds, Room B22

WS897

Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.

Oral presentation skills are a key to success for researchers and professionals alike. This course offers a no-nonsense approach to preparing and giving presentations, with a particular focus on structure, slides, and delivery. It also offers tips on how to manage the nervousness associated with speaking in public.

LEARNING OUTCOMES

This course will enable you to:
- organize your material into an effective structure
- create slides that get the message across
- deliver your presentation effectively, both verbally and nonverbally

INTENDED AUDIENCE

This course is intended for anyone who must prepare and give oral presentations about his or her research work. Both novice and experienced speakers can expect to gain a lot from it.

INSTRUCTOR

Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

Note: This course is free to student and early career attendees in SPIE Conferences. No advance registration required.

Structuring your Research Paper

Sunday 25 June 2017 · 13:30 to 17:30

Location: Fairgrounds, Room B22

WS908

Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.

Strong writing skills are a key to success for researchers and professionals alike. This course discusses how to structure research papers, dissertations, and other reports effectively at all levels to get the readers' attention, facilitate navigation, and thus get the message across optimally to their audiences.

LEARNING OUTCOMES

This course will enable you to:
- create an effective abstract, introduction, and conclusion
- organize your material into an accessible structure
- construct paragraphs that get the message across

INTENDED AUDIENCE

This course is intended for anyone who must write or edit technical documents in general and research papers in particular. Both novice and experienced authors can expect to gain a lot from it.

INSTRUCTOR

Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

Note: This course is free to student and early career attendees in SPIE Conferences. No advance registration required.

Conveying Messages with Graphs

Monday 26 June 2017 · 8:30 to 12:30

Location: Fairgrounds, Room B22

WS1202

Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.

Widely used in research and development to analyze and communicate data, graphical displays are still poorly mastered by researchers (and popular software does not helps). This course discusses how to create more effective graphs—graphs that are truly visual, are truthful to the data, and get the message across.

LEARNING OUTCOMES

This course will enable you to:
- select the right graph for a given data set and a given research question
- optimize this graph to make it intuitive and to reveal the data
- phrase a caption that gets the message across

INTENDED AUDIENCE

This course is intended for anyone who must create graphs for written documents or oral presentations. Both novice and experienced authors/speakers can expect to gain a lot from it.

INSTRUCTOR

Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

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COURSES

Get focused, effective training that you can apply directly to your work.

Register for courses and pick up course materials at the SPIE Cashier.

Course room locations will be provided at SPIE Cashier.

Using Spatial Light Modulators

NEW

SC1216

Course Level: Introductory · CEU: 0.4
$390 / € 375 Members
$445 / € 425 Non-Members
$268 / € 260 Students
Sunday 8:30 to 12:30

This course introduces the application of pixelated spatial light modulators (SLM) for imaging and non-imaging applications. First, a review of the different commercially available SLM technologies with their benefits, shortcomings and all relevant parameters will be provided. Also, the addressing of the elements and their characterization is described. Then, focus will be laid on the usage as dynamic diffractive/holographic elements. The attendee will be reminded of the most necessary issues from diffraction theory, linear systems and Fourier optics before learning how to compute and optimize holograms/diffractive optical elements.

Finally the applications patterns that enable you to employ SLMs for innovative new designs will be described and we will practice the utilization of these patterns for different optical systems.

LEARNING OUTCOMES

This course will enable you to:
- define and identify all relevant parameters for commercially available SLMs
- explain the limitations and boundary conditions when using SLMs
- list different imaging and non-imaging applications
- explain the benefits and short comings of different modulation characteristics
- predict the diffraction patterns associated with specific SLMs
- design holographic optical applications
- optimize computer-generated holograms
- describe all possible basic patterns for SLM usage
- use these basic patterns/strategies to generate innovative SLM-based systems for given applications

INTENDED AUDIENCE

This course is intended for scientists and engineers who want to understand the basics of using spatial light modulators, especially as dynamic diffractive/holographic elements. Some elementary background of wave optics is necessary (most important concepts will be recapitulated).

INSTRUCTOR

Tobias Haist is leading the group "Active Optical Systems" at the Institut fuer Technische Optik, University of Stuttgart. He has been working for more than 20 years on the application of SLMs in different fields.

Design, modeling and fabrication techniques for micro-optics: applications to display, imaging, sensing and metrology

NEW

SC1217

Course Level: Intermediate · CEU: 0.4
$390 / € 375 Members
$445 / € 425 Non-Members
$268 / € 260 Students
Sunday 13:30 to 17:30

This course provides an overview of the various design and fabrication techniques available to the optical engineer for micro / nano optics, diffractive optics and holographic optics. Emphasis is put on DFM (Design For Manufacturing) for wafer scale fabrication, Diamond Turning Machining (DTM) and holographic exposure. The course shows how design techniques can be tailored to address specific fabrication techniques' requirements and production equipment constraints. The course will also address various current application fields such as display, imaging, sensing and metrology.

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

ACCREDITED IACET PROVIDER

SPIE is accredited by the International Association for Continuing Education and Training (IACET) and is authorized to issue the IACET CEU.

SPIE reserves theright to cancel a course due to insufficient advance registration.

The course is built around 4 points: (1) design, (2) modeling, (3) fabrication/mass production and (4) application fields.

1) The course will review various design techniques used in standard optical CAD tools such as Zemax and CodeV to design Diffractive Optical Elements (DOEs), Micro-Lens Arrays (MLAs), hybrid optics and refractive micro-optics, Holographic Optical Element (HOE), as well as the various numerical design techniques for Computer Generated Holograms (CGHs).
2) Modeling single micro optics or complex micro-optical systems including MLAs, DOEs, HOEs, CGHs, and other hybrid elements can be a difficult or nearly impossible task when using classical ray tracing algorithms. We will review techniques using physical optics propagation to model not only multiple diffraction effects and their interferences, but also systematic and random fabrication errors, multi-order propagation and other effects which cannot be modeled accurately through ray tracing.
3) Following the design (1) and modeling tasks (2), the optical engineer usually needs to perform a DFM process so that his/her design can be fabricated by the target manufacturing partner/vendor on specific equipment. We will review such DFM for wafer fab via optical lithography (tape-out process), single point diamond turning (SPDT), or holographic optics recording specification. The course also reviews fracturing techniques to produce GDSII layout files for specific lithographic fabrication techniques and manufacturing equipment.
4) In order to point out the potential of such micro-optics for consumer products, this section reviews current application fields for which such elements are providing an especially good match, impossible to implement with traditional optics, such as depth mapping sensing (structured illumination based sensor) and augmented reality display (waveguide grating combiner optics). We will also review applications in high resolution incremental/absolute optical encoders. Design and modeling techniques will be described for such applications fields, and optical hardware sub-system implementations and micro-optics elements will be shown and detailed.

LEARNING OUTCOMES

This course will enable you to:

- review the various micro-optics / diffractive optics design techniques used today in popular optical design software such as Zemax and CodeV
- decide which design software would be best suited for a particular micro-optics design task
- evaluate the various constraints linked to either ray tracing or physical optics propagation techniques, and develop custom numerical propagation algorithms
- model systematic and random fabrication errors, especially for lithographic fabrication
- compare the various constraints linked to mask layout generation for lithographic fabrication (GDSII)
- review the different GDSII fabrication layout file architectures, and how to adapt them to various lithographic fabrication techniques such as the ones described in SC454
- discuss current application fields and products using such optics, as in Augmented and Mixed Reality headsets, and high resolution hybrid incremental/absolute diffractive optical encoders.

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about how to design, model, fabricate and test micro-optics, diffractive optics and hybrid micro-optics, and how such optics can be integrated effectively in consumer products. Basic knowledge in optics is assumed.

INSTRUCTOR

Bernard Kress has made over the past two decades significant scientific contributions as an engineer, researcher, associate professor, consultant, instructor, and author. He has been instrumental in developing numerous optical sub-systems for consumer electronics and industrial products, generating IP, teaching and transferring technological solutions to industry. Application sectors include laser materials processing, optical anti-counterfeiting, biotech sensors, optical telecom devices, optical data storage, optical computing, optical motion sensors, digital image projection, digital displays systems, computational imaging and display, depth map and gesture sensors, and HMD/HUD displays (as in smart glasses, AR/MR and VR). Bernard is specifically involved in the field of micro-optics, wafer scale optics, holography and nanophotonics. He has published numerous books and book chapters on micro-optics and has more than 35 patents granted worldwide. He is a short course instructor for the SPIE since a decade and has been involved in numerous SPIE conferences as technical committee member and conference co-chair and chair. He is an SPIE fellow since 2013 as has been elected to the board of Directors of SPIE (2017-19). Bernard has joined Google [X] Labs. in 2011 as the Principal Optical Architect on the Google Glass project, and is since 2015 the Partner Optical Architect at Microsoft Corp. in the Hololens project.

Optical technologies and architectures for Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) Head Mounted Displays (HMDs)

NEW

SC1218

Course Level: Intermediate · CEU: 0.4

$390 / € 375 Members
$445 / € 425 Non-Members
$268 / € 260 Students

Sunday 8:30 to 12:30

The course starts by providing an extensive overview of the numerous optical technologies and architectures implemented in today's wearable display consumer products such as in:

- Smart glasses and digital eyewear
- Augmented Reality (AR) and Mixed Reality (MR) headsets
- Virtual Reality (VR) and Merged Reality headsets

The course describes the optical backbone of such head worn systems, and the various optical sub-systems building blocks are listed and analyzed. They include:

- Depth mapping sensors (either though structured illumination or time of flight)
- Head tracking sensors (either IMU or camera based)
- Gaze tracking sensors
- Display engines including microdisplay panels, scanner based light engines and diffractive phase panels
- Optical combiners integrated either in free space or waveguide platforms

Emphasis is put on the design and fabrication techniques to provide the best immersion and comfort to the end user, along the following guidelines:

- Wearable comfort (size/ weight, center of gravity)
- Visual comfort (eye box size and IPD coverage, resolution, field of view, distortion, dynamic range, stereo overlay amount)
- Vergence / accommodation disparity (varifocal, multifocal, light fields and holographic displays)
- Foveated rendering and peripheral displays
- Pupil swim and active distortion compensation

The advantages and limitations of the various optical technologies addressing such specifications are reviewed and analyzed.

More specifically, emphasis will be put on eyebox definition as an experienced spec, subsequent eyebox replication and eyebox enlargement techniques as well as alternative eyebox generation techniques.

In order to design next generation head worn systems, one needs to fully understand the specifics and limitations of the human visual system, and design the optics and the optical architecture around such.

The course also lists the main challenges still lying ahead for next generation headworn systems, where immersion and comfort need to be addressed in concert. The course reviews how such drastic optomechanical specs may be addressed without compromising the features required to provide the user with the ultimate AR/VR experience.

Finally, the course reviews the major market analysts expectations for VR and AR, projected over the next 5 to 10 years, and lists the main actors (major consumer companies as well as start-ups and current investment rounds in such). Demonstration of some of the state of the art AR, MR and VR headsets will be offered to attendees at the end of the course.

LEARNING OUTCOMES

This course will enable you to:

- Explain the various consumer and enterprise head worn systems available in industry today, declined as smart glasses, digital eyewear, AR, MR and VR HMDs, and understand their fundamental differences and specifics.

- Explain the current optical technologies and sub-systems used in VR, AR and MR head worn systems, their advantages and limitations (such as depth mapping sensors, head tracking sensors, display engines, combiner optics, gaze trackers,…).
- Explain the relations and implications between FOV, resolution, MTF, eyebox size, effective IPD coverage, screen door effects, pupil swim, vergence/accommodation disparity, foveated rendering, peripheral displays, etc.
- Explain the limitations of current optical architectures and how such can be overcome by designing the optics around the human visual system. Gain a good understanding of the human visual system, its specifics and limitations.
- Explain the requirement for next generation head worn AR and VR systems, and review the critical enabling technologies.
- Discuss the current AR/VR market status as well as the upcoming market expectations for each field (smart glasses, AR and VR).

INTENDED AUDIENCE

Optical, mechanical and electrical engineers involved in the design and production of head mounted displays in all their declinations.

Product managers, project managers and upper management involved in defining next generation head mounted display products, technology product roadmaps and next generation optical sub-systems.

Technology review analysts involved in AR and VR.

INSTRUCTOR

Bernard Kress has made over the past two decades significant scientific contributions as an engineer, researcher, associate professor, consultant, instructor, and author. He has been instrumental in developing numerous optical sub-systems for consumer electronics and industrial products, generating IP, teaching and transferring technological solutions to industry. Application sectors include laser materials processing, optical anti-counterfeiting, biotech sensors, optical telecom devices, optical data storage, optical computing, optical motion sensors, digital image projection, digital displays systems, computational imaging and display, depth map and gesture sensors, and HMD/HUD displays (as in smart glasses, AR/MR and VR). Bernard is specifically involved in the field of micro-optics, wafer scale optics, holography and nanophotonics. He has published numerous books and book chapters on micro-optics and has more than 35 patents granted worldwide. He is a short course instructor for the SPIE since a decade and has been involved in numerous SPIE conferences as technical committee member and conference co-chair and chair. He is an SPIE fellow since 2013 as has been elected to the board of Directors of SPIE (2017-19). Bernard has joined Google [X] Labs. in 2011 as the Principal Optical Architect on the Google Glass project, and is since 2015 the Partner Optical Architect at Microsoft Corp, in the Hololens project.

Joint design of optics and image processing in computational sensing and imaging

NEW

SC1219

Course Level: Introductory · CEU: 0.4

$390 / € 375 Members
$445 / € 425 Non-Members
$268 / € 260 Students

Sunday 13:30 to 17:30

This course provides an overview of the motivation, theory and basic examples of joint design of optics and image processing in computational sensing and imaging systems in which image processing performs significant, non-trivial role in creating the final digital output.

1) The course will review the history of optical imaging and its four revolutions: 1) forming a real image with lenses and curved mirrors through basic physical optics, 2) fixing the image with silver halide through photography, 3) capturing the image using CCDs and CMOS image sensors through digital photography, and 4) deep integration of optics and signal processing through computational imaging, where an image or image estimate is not simply captured but instead computed.
2) Joint design of imaging systems based on traditional lenses and linear signal processing, including electro-optical compensation for manufacturing variations.
3) Lensless computational sensing and imaging based on diffraction (rather than refraction or reflection).
4) Joint design of application-specific sensors, in which the output is not a two-dimensional digital image but instead a numerical output or discrete decision based on the input scene.

LEARNING OUTCOMES

This course will enable you to:

- Explain the technological and economic forces that have led to the paradigm of computational imaging.
- Explain the role of joint electro-optical design merit function for unifying the design of such imaging systems.
- Explain the key role of noise and signal regularization in image estimation.
- Explain mathematics needed to design and characterize such systems, such as condition number of system matrices, mean-squared error merit functions, and L1 and L2 regularization.

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about new methods for designing optical sensing and imaging systems in which digital processing is an essential step in the dataflow. Basic knowledge in optics and signal processing is assumed.

INSTRUCTOR

David Stork is Rambus Fellow in Rambus Labs, Sunnyvale CA, where he leads research in its Computational Sensing and Imaging Group. He is a graduate in Physics from MIT and the University of Maryland and has published eight book/proceedings volumes including Seeing the light: Optics in nature, photography, color, vision and holography and Pattern classification (2nd ed.). He has held faculty positions in Physics, Mathematics, Computer Science, Electrical Engineering, Statistics, Neuroscience, Psychology and Art and Art History variously at Wellesley and Swarthmore Colleges and Clark, Boston and Stanford Universities. He has authored or co-authored over 200 technical publications, holds 49 issued patents, and is a Fellow of the Optical Society of America (OSA), Society for Photographic Instrumentation and Engineering (SPIE), International Association for Pattern Recognition (IAPR) and International Academy, Research and Industry Association (IARIA).

COURSE INSTRUCTOR SPOTLIGHT

Bernard Kress

Over the past two decades Bernard Kress has made significant scientific contributions as an engineer, researcher, associate professor, consultant, instructor, and author. He has been instrumental in developing numerous optical sub-systems for consumer electronics and industrial products, generating IP, teaching and transferring technological solutions to industry.

What attendees have said about his courses:

- The instructor is very knowledgeable in AR/VR and presented an extremely interesting course.
- Excellent course. Bernard has a lot of energy and enthusiasm!!
- Excellent presentation. Very thorough and generous at answering questions.

Don't miss the Augmented Reality / Virtual Reality Hands-On Demo Sessions, see p. 4.

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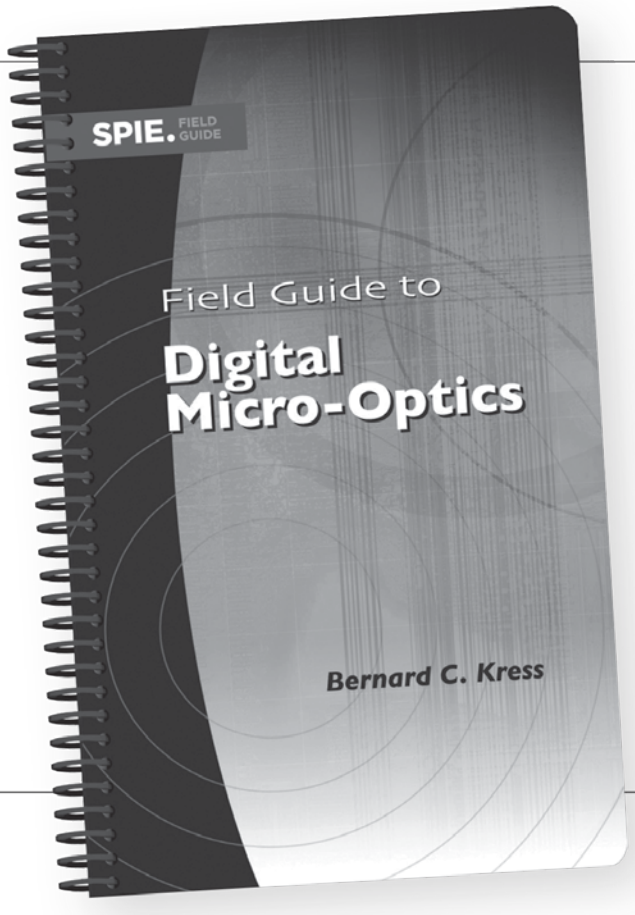

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SPIE. OPTICAL METROLOGY

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- 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

CONFERENCE 10329 · LOCATION: 14C

Monday - Thursday 26–29 June 2017 • Proceedings of SPIE Vol. 10329

Optical Measurement Systems for Industrial Inspection X

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

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MONDAY 26 JUNE

LOCATION: 14C . . . . . 8:25 TO 8:30

Welcome and Introduction

SESSION 1

LOCATION: 14C . . . . . MON 8:30 TO 10:00

Interometric Techniques I

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

8:30: **Optical metrology in industry: exciting times and some history** *(Invited Paper)*, John H. Bruning, Corning Tropel Corp. (USA) . . . . . .[10329-1]

9:00: **Polarization and phase shifting interferometry**, Sergej Rothau, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Klaus Mantel, Max-Planck-Institut für die Physik des Lichts (Germany); Norbert Lindlein, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) . . . . . .[10329-2]

9:20: **Increasing the accuracy of tilted-wave-interferometry by elimination of systematic errors**, Johannes Schindler, Univ. Stuttgart (Germany); Christof Pruss, Wolfgang Osten, Institut für Technische Optik (Germany). . . . .[10329-3]

9:40: **Full-field heterodyne dynamic interferometry based on hertz-level low differential-frequency acousto-optic frequency shifter**, Zhou Wu, Academy of Opto-Electronics, CAS (China) and Univ. of Chinese Academy of Sciences (China); Wenxi Zhang, Bin Xiangli, Xinxin Kong, Academy of Opto-Electronics (China). . . . . .[10329-4]

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

LOCATION: SAAL 1, ICM . . . . . MON 10:00 TO 11:00

Putting a Spin on Photons

Jörg Wachtrup, Univ. of Stuttgart (Germany)

For details, please see page 3, or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

SESSION 2

LOCATION: 14C . . . . . MON 11:20 TO 12:40

Interometric Techniques II

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

11:20: **Phase imaging using a single-pixel camera**, Yoshio Hayasaki, Kazuki Ota, Utsunomiya Univ. (Japan) . . . . . .[10329-5]

11:40: **Applications of digital interferometer**, Sen Han, Univ. of Shanghai for Science and Technology (China). . . . . .[10329-6]

12:00: **Spatial-temporal phase shifting interferometry: suppressing phase errors in dynamic Fizeau interferometer**, Wenhua Zhu, Lei Chen, Rihong Zhu, Rui Zhang, Donghui Zheng, Nanjing Univ. of Science and Technology (China) . . . . . .[10329-7]

12:20: **Study on measurement accuracy of active optics null test systems based on liquid crystal spatial light modulator and laser interferometer**, Shijie Liu, Shanghai Institute of Optics and Fine Mechanics (China); Longbo Xu, Nanjing Univ. of Science and Technology (China); Xiao Ma, Zhigang Zhang, You Zhou, Qi Lu, Shanghai Institute of Optics and Fine Mechanics (China); Yunbo Bai, Shaqnghai Institute of Optics and Fine Mechanics (China); Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . .[10329-8]

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

SESSION 3

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

Digital Holography and Holographic Microscopy

Session Chair: **Pietro Ferraro,** Istituto di Scienze applicata e Sistemi Intelligenti (Italy)

14:00: **Evaluation of refocus criteria for holographic particle imaging**, Pascal Picart, Univ. du Maine (France); Soumaya Kara-Mohammed, Larbi L. Bouamama, Derradji Bahloul, Univ. Ferhat Abbas de Sétif (Algeria) . .[10329-9]

14:20: **Topography measurements of high NA aspherical microlenses by digital holographic microscopy with spherical illumination**, Michal Józwik, Warsaw Univ. of Technology (Poland); Marta Mikuła, Warsaw Univ of Technology (Poland); Tomasz Kozacki, Julianna Kostencka, Warsaw Univ. of Technology (Poland); Christophe Gorecki, FEMTO-ST (France). . . . .[10329-10]

14:40: **Digital holography on moving objects: multiwavelength height measurements on inclined surfaces**, Annelie Schiller, Tobias Beckmann, Markus Fratz, Dominik Belzer, Alexander Bertz, Daniel Carl, Fraunhofer-Institut für Physikalische Messtechnik (Germany); Karsten Buse, Fraunhofer-Institut für Physikalische Messtechnik (Germany) and Univ. of Freiburg (Germany) . . . . . .[10329-11]

15:00: **A method for total noise removal in digital holography based on enhanced grouping and sparsity enhancement filtering**, Vittorio Bianco, Pasquale Memmolo, Melania Paturzo, Andrea Finizio, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10329-13]

15:20: **Miniaturized multiwavelength digital holography sensor for extensive in-machine tool measurement**, Tobias Seyler, Markus Fratz, Tobias Beckmann, Alexander Bertz, Daniel Carl, Fraunhofer-Institut für Physikalische Messtechnik (Germany) . . . . . .[10329-14]

15:40: **High-throughput single-shot hyperspectral interferometer for areal profilometry based on microlens array integral field unit**, Pablo D. Ruiz, Jonathan M. Huntley, Loughborough Univ. (United Kingdom) . . . . .[10329-179]

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

SESSION 4

LOCATION: 14C . . . . . MON 16:30 TO 18:10

OCT and Coherence Scanning

Session Chair: **Christian Rembe,** Technische Univ. Clausthal (Germany)

16:30: **Tomographical process monitoring of laser transmission welding with OCT**, Philippe Ackermann, Fraunhofer-Institut für Produktionstechnologie IPT (Germany); Robert H. Schmitt, RWTH Aachen Univ. (Germany) .[10329-15]

16:50: **Non-destructive testing of layer-to-layer fusion of a 3D print using ultrahigh resolution optical coherence tomography**, Niels M. Israelsen, Technical Univ. of Denmark (Denmark); Michael Maria, Univ. of Kent (United Kingdom) and NKT Photonics Inc. (Denmark); Thomas Feuchter, NKT Photonics A/S (Denmark); Adrian Podoleanu, Univ. of Kent (United Kingdom); Ole Bang, DTU Fotonik (Denmark) . . . . . .[10329-16]

17:10: **Applications of optical coherence tomography in the non-contact assessment of automotive paints**, Samuel J. Lawman, Jinke Zhang, Bryan M. Williams, Yalin Zheng, Yao-Chun Shen, Univ. of Liverpool (United Kingdom) . . . . . .[10329-17]

17:30: **Single-shot multilayer measurement by chromatic confocal coherence tomography**, Tobias Boettcher, Marc Gronle, Wolfgang Osten, Institut für Technische Optik (Germany) . . . . . .[10329-18]

17:50: **Tolerance on sphere radius for the calibration of the transfer function of coherence scanning interferometry**, Rong Su, The Univ. of Nottingham (United Kingdom); Jeremy M. Coupland, Loughborough Univ. (United Kingdom); Yuhang Wang, Harbin Institute of Technology (China); Richard K. Leach, The Univ. of Nottingham (United Kingdom). . . . . .[10329-19]

TUESDAY 27 JUNE

SESSION 5

LOCATION: 14C . . . . . TUE 8:30 TO 10:00

High-Speed Techniques

Session Chair: **Ralf B. Bergmann,** Bremer Institut für angewandte Strahltechnik GmbH (Germany)

8:30: **New challenges for optical inspection in the times of industry 4.0** *(Invited Paper)*, Robert H. Schmitt, RWTH Aachen Univ. (Germany) .[10329-20]

9:00: **GOBO projection for underwater 3D measurement technique**, Peter Kühmstedt, Christian Bräuer-Burchardt, Stefan Heist, Ingo Schmidt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Technical Univ. Ilmenau (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany). . . . . .[10329-21]

9:20: **Verification of real sensor motion for a high-dynamic 3D measurement inspection system**, Andreas Breitbarth, Martin Correns, Technische Univ. Ilmenau (Germany); Manuel Zimmermann, GÖPEL electronic GmbH (Germany); Chen Zhang, Maik Rosenberger, Technische Univ. Ilmenau (Germany); Jörg Schambach, GÖPEL electronic GmbH (Germany); Gunther Notni, Technische Univ. Ilmenau (Germany) . . . . . .[10329-22]

9:40: **High speed imaging for assessment of impact damage in natural fibre biocomposites**, Karthik Ram Ramakrishnan, Stephane Corn, Nicolas Le Moigne, Patrick Ienny, Romain Leger, Pierre R. Slangen, Mines Alès (France) . . . . . .[10329-23]

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

SESSION 6

LOCATION: 14C . . . . . TUE 10:30 TO 11:30

Fringe Projection I

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

10:30: **Miniaturization of an optical 3D sensor by additive manufacture of metallic mirrors**, Andre Sigel, Markus Merkel, Andreas Heinrich, Hochschule Aalen (Germany) . . . . . .[10329-24]

10:50: **Platform for 3D inline - process - control in additive manufacturing**, Marc Preissler, Chen Zhang, Maik Rosenberger, Gunther Notni, Technische Univ. Ilmenau (Germany) . . . . . .[10329-26]

11:10: **Flexible registration method for light-stripe sensors considering sensor misalignments**, Waldemar Gorschenew, Markus Kästner, Eduard Reithmeier, Leibniz Univ. Hannover (Germany). . . . . .[10329-27]

Lunch Break . . . . . Tue 11:30 to 12:50

POSTERS—TUESDAY

LOCATION: ICM FOYER . . . . . TUE 12:50 TO 14:10

Conference attendees are invited to attend the Optical Metrology Poster Session 1 on Tuesday. 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 12:50 through 14:10 hrs on Thursday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Parallelism measurement of plane glass at oblique incidence by interferometry, Yi Yang, Lin Zhang, China Academy of Engineering Physics (China) . . . . . .[10329-73]

New technique for generating light source array in tilted wave interferometer, Jia Li, Hua Shen, Rihong Zhu, Qing Lu, Nanjing Univ. of Science and Technology (China). . . . . .[10329-74]

Absolute test using the conjugate differential method, Ya Huang, Jun Ma, Nanjing Univ. of Science and Technology (China); Caojin Yuan, Nanjing Normal Univ. (China); Lei Chen, Rihong Zhu, Zhishan Gao, Nanjing Univ. of Science and Technology (China). . . . . .[10329-75]

Optical scanner system for high resolution measurement of lubricant distributions on metal strips based on laser induced fluorescence, Philipp Holz, Christian Lutz, Albrecht C. Brandenburg, Fraunhofer-Institut für Physikalische Messtechnik (Germany) . . . . . .[10329-79]

Characterizing the quality of the fiber optic reference for cylindrical wave testing, Ayshah Alatawi, Tabuk Univ. (Saudi Arabia); Patrick J. Reardon, The Univ. of Alabama in Huntsville (USA). . . . . .[10329-80]

Fiber Bragg grating vibration measurement device, Sharath Umesh, Shweta Pant, Srivani Padma, Sundarrajan Asokan, Indian Institute of Science (India). . . . . .[10329-81]

Analysis of the fractures of metallic materials using optical coherence tomography, Gheorghe Hutiu, Aurel Vlaicu Univ. of Arad (Romania); Virgil-Florin Duma, Aurel Vlaicu Univ. of Arad (Romania) and Polytechnic Univ. of Timisoara (Romania); Dorin Demian, Aurel Vlaicu Univ. of Arad (Romania); Adrian Bradu, Adrian Podoleanu, Univ. of Kent (United Kingdom) . . .[10329-82]

A novel white-light interferometry using low differential-frequency heterodyne system, Xinxin Kong, Beihang Univ. (China), Academy of Opto-Electronics, CAS (China); Bin Xiangli, Beihang Univ. (China); Wenxi Zhang, Zhou Wu, Yang Li, Xiaoyu Lv, Academy of Opto-Electronics, CAS (China).[10329-83]

Fiber Bragg gratings strain measuring system and a sensor calibration setup based on mechanical nanomotion transducer, Vladimir A. Lazarev, Stanislav O. Leonov, Mikhail K. Tarabrin, Valerii E. Karasik,, Bauman Moscow State Technical Univ. (Russian Federation). . . . . .[10329-84]

Evaluation and tolerancing of irregularly shaped interferometric test regions, Christian Beder, Carl Zeiss Meditec AG (Germany); Martin Peschka, Carl Zeiss AG (Germany). . . . . .[10329-85]

Remote sensing of atmospheric turbulence profiles by laser guide stars, Xiwen Qiang, Tianhua Liu, Shuanglian Feng, Fei Zong, Min Wu, Jinyong Chang, Junwei Zhao, China Satellite Launch & Tracking Control General (China) . . . . . .[10329-86]

Laser-line scanning speckle reduction based on a one-dimensional beam homogenizer, Bryan L. Nelsen, Paul Jacobs, Westsächsische Hochschule Zwickau (Germany); Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) . . . . . .[10329-87]

High-power LED light sources for optical measurement systems operated in continuous and overdriven pulsed modes, Boleslaw Stasicki, Andreas Schröder, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Fritz Boden, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (Germany); Krzysztof Ludwikowski, HARDsoft Microprocessor Systems (Poland)[10329-88]

The research of structured reflective surface of matrix sensor according to generalized scheme of ellipsometry, Anastasiya Y. Lobanova, Anastasia A. Blokhina, Victoria A. Ryzhova, Valery V. Korotaev, Victor M. Denisov, ITMO Univ. (Russian Federation). . . . . .[10329-89]

A metrological comparison of Raman-distributed temperature sensors, Guillaume Failleau, Olivier Beaumont, Refat Razouk, Lab. National de Metrologie et d'Essais (France); Sylvie Delepine-Lesoille, ANDRA (France); François Martinot, EDF - DTG Grenoble (France); Johan Bertrand, ANDRA (France); Bruno Hay, Lab. National de Metrologie et d'Essais (France) . . . . . .[10329-90]

Phase A: calibration concepts for HIRES, Philipp Huke, Georg-August-Univ. Göttingen (Germany); Livia Origlia, INAF - Osservatorio Astronomico di Bologna (Italy); Marco Riva, Observatoire de Genève (Switzerland); Jake M. Charsley, Richard A. McCracken, Derryck T. Reid, Heriot-Watt Univ. (United Kingdom); Grzegorz Kowzan, Piotr Maslowski, Nicolaus Copernicus Univ. (Poland); Karen Disseau, Sebastian Schäfer, Georg-August-Univ. Göttingen (Germany); Christopher Broeg, Mirsad Sarajlic, Univ. Bern (Switzerland); François Dolon, Observatoire de Haute-Provence (France); Heidi Korhonen, Dark Cosmology Ctr. (Denmark); Ansgar Reiners, Georg-August-Univ. Göttingen (Germany); Isabelle Boisse, Lab. d'Astrophysique de Marseille (France); Sandrine Perruchot, Observatoire de Haute-Provence (France); Sebastien Ottogalli, Lab. J.L. Lagrange (France); Francesco Pepe, Observatoire de Genève (Switzerland); Ernesto Oliva, INAF - Osservatorio Astrofisico di Arcetri (Italy). . . . . .[10329-91]

Femtosecond Z-scan measurements of the nonlinear refractive index of fused silica, Lin Zhang, Huan Ren, Zhendong Shi, Yi Yang, Hua Ma, China Academy of Engineering Physics (China) . . . . . .[10329-92]

Neural network and optical fiber sensor as intelligent heart rate monitor, Kussay N. M. Al-Zubaidi, Mohamad Zubir Mat Jafri, Univ. Sains Malaysia (Malaysia). . . . . .[10329-93]

Development of hydrogen sensors based on fiber Bragg grating with a palladium foil for online dissolved gas analysis in transformers, Maximilian Fisser, Rodney A Badcock, Robinson Research Institute (New Zealand); Paul D. Teal, Victoria Univ. of Wellington (New Zealand); Adam J Swanson, Callaghan Innovation (New Zealand); Arvid Hunze, Robinson Research Institute (New Zealand). . . . . .[10329-94]

Development of a low-cost, 11 µm spectral domain optical coherence tomography surface profilometry prototype, Nyasha J. Suliali, Peter Baricholo, National Univ. of Science and Technology (Zimbabwe); Pieter H. Neethling, Erich G. Rohwer, Stellenbosch Univ. (South Africa) . . . . .[10329-95]

Gas monitoring onboard ISS using FTIR spectroscopy, Michael Gisi, Armin Stettner, Roland Seurig, OHB-System AG (Germany); Atle Honne, SINTEF (Norway); Johannes Witt, Pierre Rebeyre, European Space Research and Technology Ctr. (Netherlands). . . . . .[10329-96]

Experimental light scattering by small particles: system design and calibration, Göran Maconi, Ivan Kassamakov, Antti Penttilä, Maria Gritsevich, Edward Hæggström, Karri Muinonen, Univ. of Helsinki (Finland) . . . .[10329-97]

Light section measurement to quantify the accuracy loss induced by laser light deflection in an inhomogeneous refractive index field, Rüdiger Beermann, Lorenz Quentin, Andreas Pösch, Eduard Reithmeier, Markus Kästner, Leibniz Univ. Hannover (Germany) . . . . . .[10329-98]

Digital holographic inspection for drying processes of paint films and ink dots, Masayuki Yokota, Fumiya Aoyama, Shimane Univ. (Japan) . . .[10329-99]

Development of optical-electronic autocollimation sensor for industrial inspection with an increased measurement range, Aiganym Sakhariyanova, Igor A. Konyakhin, Renpu Li, ITMO Univ. (Russian Federation) . . . .[10329-100]

Influence of the limited detector size on spatial variations of the reconstruction accuracy in holographic tomography, Julianna Kostencka, Tomasz Kozacki, Warsaw Univ. of Technology (Poland); Bryan Hennelly, Department of Electronic Engineering, National University of Ireland (Ireland) and Department of Computer Science, National University of Ireland (Ireland); John T. Sheridan, School of Electrical, Electronic and Communication Engineering, University College Dublin (Ireland) . . . . . .[10329-102]

High-precision surface measurement of long-radius concave sphere with diverging transmission, Gaofeng Wu, Institute of Electronics (China) . . . . . .[10329-103]

New method for probe position correction for ptychography, Priya Dwivedi, Sander Konijnenberg, Silvania Pereira, Hendrik P. Urbach, Technische Univ. Delft (Netherlands). . . . . .[10329-104]

Holographic prism based on photo-thermo-refractive glass, Sergei Ivanov, Alexsandr Angervaks, Doan Van Bac, Nikolay Nikonorov, Roman Okun', ITMO Univ. (Russian Federation). . . . . .[10329-105]

Component-level test of molded freeform optics for LED beam shaping using experimental ray tracing, Gustavo Gutierrez, Hochschule Bremen (Germany); David Hilbig, Friedrich Fleischmann, Thomas Henning, Hochschule Bremen Univ. of Applied Sciences (Germany) . . . . . .[10329-106]

Characterization of batwing effects in precision low-coherence interferometry using broadband light sources, Christopher Taudt, Westsächsische Hochschule Zwickau (Germany); Tobias Baselt, Westsachsische Hochschule Zwickau (Germany); Bryan L. Nelsen, Westsächsische Hochschule Zwickau (Germany); Heiko Assmann, Infineon Dresden GmbH (Germany); Andreas Greiner, Infineon Technologies Dresden (Germany); Edmund Koch, Technische Univ. Dresden (Germany); Peter Hartmann, Westsachsische Hochschule Zwickau (Germany). . . . . .[10329-108]

In-line full-field optical 3D surface inspection and metrology for mass production system, Rob Snel, TNO (Netherlands) . . . . . .[10329-109]

Compact DPSS-laser source for LIBS analysis of steel, Andreas Tortschanoff, Marcus Baumgart, Gerhard Kroupa, CTR Carinthian Tech Research AG (Austria) . . . . . .[10329-110]

Defect detection in translucent materials by thermal stressing using lensless Fourier transform digital holography, Vismay Trivedi, Swapnil Mahajan, Mugdha Joglekar, Vani K. Chhaniwal, The Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (USA); Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India) . . . . . .[10329-111]

Design and fabrication of micro silica sphere cavity force sensor based on hybrid Fabry Perot interferometer, Omid R. Ranjbar Naeini, Forough Jafari, Pegah Zarafshani, Mohammad I. Zibaii, Hamid Latifi, Shahid Beheshti Univ. (Iran, Islamic Republic of) . . . . . .[10329-112]

Fast searching measurement of absolute displacement based on submicron-aperture fiber point-diffraction interferometer, Daodang Wang, Zhichao Wang, China Jiliang Univ. (China); Rongguang Liang, College of Optical Sciences, The Univ. of Arizona (USA); Ming Kong, Jun Zhao, China Jiliang Univ. (China); Jufeng Zhao, Hangzhou Dianzi Univ. (China); Linhai Mo, Volkslift (China) Company Limited, Huzhou 313009, China (China); Wei Li, China Jiliang Univ. (China). . . . . .[10329-113]

Autocollimation system for measuring angular deformations with reflector designed by quaternionic method, Van Phong Hoang, Igor A. Konyakhin, ITMO Univ. (Russian Federation). . . . . .[10329-114]

Steps towards traceability for an asphere interferometer, Ines Fortmeier, Manuel Stavridis, Clemens Elster, Michael Schulz, Physikalisch-Technische Bundesanstalt (Germany) . . . . . .[10329-115]

Principles of radiation terrain mapping with SiPM gamma spectrometer, Anna V. Trushkina, Victoria A. Ryzhova, Valery V. Korotaev, ITMO Univ. (Russian Federation); Victor M. Denisov, ITMO Univ. (Russian Federation) and Flagman-geo Ltd. (Russian Federation); Andrey V. Radilov, Flagman-geo Ltd. (Russian Federation) . . . . . .[10329-117]

The spatial concentration of dust emissions measured by using 3D scanning lidar in the open storage yards of steel-making company, Chih-Wei Chiang, Hong-Wei Chiang, Huann-Ming Chou, Shu-Huang Sun, Kun Shan Univ. (Taiwan); Jiann-Shen Lee, China Steel Corp. (Taiwan) . . . . . .[10329-118]

Optoelectronic joined-channel autocollimator for measuring three angular coordinates, Anton A. Nogin, Igor A. Konyakhin, ITMO Univ. (Russian Federation) . . . . . .[10329-120]

Interferometric signals analysis based on the extended Kalman filter tuned by machine learning technique, Petr A. Ermolaev, Maxim A. Volynsky, ITMO Univ. (Russian Federation). . . . . .[10329-122]

The small-sized ultraprecision sensor for measuring linear displacements, Dmitrii S. Lushnikov, Alexander Y. Zherdev, Sergey B. Odinokov, Vladimir V. Markin, Oleg A. Gurylev, Maria V. Shishova, Bauman Moscow State Technical Univ. (Russian Federation). . . . . .[10329-123]

Simulation of multispectral multisource for device of consumer and medicine products analysis, Timofey Korolev, Vladimir S. Peretiagin, ITMO Univ. (Russian Federation). . . . . .[10329-125]

On-line hyperspectral imaging system for evaluating quality of agricultural products, Changyeun Mo, Giyoung Kim, Jongguk Lim, National Institute of Agricultural Sciences (Korea, Republic of) . . . . . .[10329-126]

Enhancement of spatial resolution in digital holographic microscopy using speckle field generated from ring-slit apertures, Hideki Funamizu, Yusei Onodera, Muroran Institute of Technology (Japan); Jun Uozumi, Hokkai-Gakuen Univ. (Japan); Yoshihisa Aizu, Muroran Institute of Technology (Japan). . . . . .[10329-127]

Phase and group refractive indices of air calculation by fitting of phase difference measured using a combination of laser and low-coherence interferometry, Tomáš Pikálek, Martin Šarbort, Ondřej Cip, Minh Tuan Pham, Adam Lešundák, Lenka Pravdová, Zdeněk Buchta, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic). . . . . .[10329-128]

Very high aspect ratio through silicon via reflectometry, Joachim Bauer, Friedhelm Heinrich, Technische Hochschule Wildau (Germany); Oksana Fursenko, Steffen Marschmeyer, IHP GmbH (Germany); Adrian Bluemich, SENTECH Instruments GmbH (Germany); Silvio Pulwer, Patrick Steglich, Claus Villringer, Technische Hochschule Wildau (Germany); Andreas Mai, IHP GmbH (Germany); Sigurd Schrader, Technische Hochschule Wildau (Germany) . . . . . .[10329-129]

Application of identifying transmission spheres for spherical surface testing, Christopher B. Han, Suzhou Singapore International School (China); Xin Ye, Univ. of Shanghai for Science and Technology (China) and Suzhou H&L Instruments LLC (China); Xueyuan Li, Suzhou H&L Instruments LLC (China); Quanzhao Wang, Suzhou W&N Instruments LLC (China); Shouhong Tang, Univ. of Shanghai for Science and Technology (China) and Suzhou H&L Intstruments LLC (China); Sen Han, Univ. of Shanghai for Science and Technology (China) and Suzhou H&L Instruments LLC (China) . . . . . .[10329-130]

Investigation of accuracy characteristics of circular photodetector: Multiscan, Kirill S. Povarov, Sergey S. Mitrofanov, ITMO Univ. (Russian Federation) . . . . . .[10329-131]

Optical measurement system of microcomponents flatness by Moiré interferometry, Saïd Meguellati, Univ. Ferhat Abbas de Sétif (Algeria) . . . . . .[10329-132]

High precision laser photometer for laser optics, Yuanan Zhao, Guohang Hu, Zhen Cao, Shijie Liu, Meiping Zhu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China). . . . . .[10329-133]

Analysis on optical heterodyne frequency error of full-field heterodyne interferometer, Yang Li, Wenxi Zhang, Zhou Wu, Xiaoyu Lv, Xinxin Kong, Xiaoli Guo, Academy of Opto-Electronics, CAS (China). . . . . .[10329-134]

An optical flow-based method for velocity field of fluid flow estimation, Grzegorz Glomb, Grzegorz Swirniak, Janusz Mroczka, Wroclaw Univ. of Technology (Poland) . . . . . .[10329-135]

Phase detection model and method for SPR effect modulated by metallic thickness, Qinggang Liu, Yang Li, Zirui Qin, Chong Yue, Tianjin Univ. (China) . . . . . .[10329-136]

Combined narrowband imager-spectrograph with volume-phase holographic gratings, Eduard R. Muslimov, Aix-Marseille Univ. (France) and Kazan National Research Technical Univ. named after A.N. Tupolev (Russian Federation); Sergei N. Fabrika, Special Astrophysical Observatory (Russian Federation); Gennady G. Valyavin, Special Astrophysical Observatory (Russian Federation) . . . . . .[10329-137]

Heterodyne grating interferometry based on sinusoidal phase modulation for displacement measurement, Ju-Yi Lee, National Central Univ. (Taiwan); Hung-Lin Hsieh, National Taiwan Univ. of Science and Technology (Taiwan); Zhi-Ying Lin, National Central Univ. (Taiwan) . . . . . .[10329-138]

Optical exploration of micro/nanoscale irregularities created on metallic surfaces by femtosecond laser irradiation, Hamid Ahmadi, Mahmoud Mollabashi, Iran Univ. of Science and Technology (Iran, Islamic Republic of); Sepehr Razi, Urmia Univ. (Iran, Islamic Republic of). . . . . .[10329-139]

Universal dynamic goniometer for rotary encoders, Nikolai V. Smirnov, Svjatoslav M. Latyev, Anastasiia I. Naumova, ITMO Univ. (Russian Federation) . . . . . .[10329-140]

Estimation of clearances in the design and adjustment of barrel type lens systems, Pavel Beloivan, Svyatoslav M. Latyev, Dmitri Frolov, ITMO Univ. (Russian Federation); Rene Theska, Technische Univ. Ilmenau (Germany) . . . . . .[10329-141]

Self-tunable phase shifting algorithm for images with additive noise, Gastón A. Ayubi, Univ. de la República (Uruguay) . . . . . .[10329-142]

Revealing features of different optical shaping technologies by a point diffraction interferometer, Nikolay B. Voznesenskiy, Mariia Voznesenskaia, Diwaker Jha, Difrotec OÜ (Estonia); Heidi Ottovaere, Vrije Universiteit Brussel, Institute of Micromechanics and Photonics (Belgium); Małgorzata Kujawińska, Maciej Trusiak, Kamil Liżewski, Warsaw University of Technology (Poland) . . . . . .[10329-143]

Pointwise intensity-based dynamic speckle analysis with binary patterns, Elena Stoykova, Georgi Mateev, Dimana Nazarova, Nataliya Berberova, Institute of Optical Materials and Technologies (Bulgaria); Branimir Ivanov, Central Lab. of Optical Storage and Processing of Information (Bulgaria) . . . . . .[10329-144]

Full-field wafer warpage measurement technique, Hung-Lin Hsieh, National Taiwan Univ. of Science and Technology (Taiwan); Ju-Yi Lee, National Central Univ. (Taiwan); Yong-Guang Huang, An-Jie Liang, Bo-Yen Sun, National Taiwan Univ. of Science and Technology (Taiwan) . . . . . .[10329-145]

Vibration compensated high-resolution scanning white-light Linnik-interferometer, Stanislav Tereschenko, Peter Lehmann, Peter Kühnhold, Pascal Gollor, Univ. Kassel (Germany) . . . . . .[10329-147]

Modern approaches for optical multisensor systems design, Yuri P. Baranov, ITMO Univ. (Russian Federation) and Urals Optical and Mechanical Plant (Russian Federation); Sergey N. Yarishev, ITMO Univ. (Russian Federation); Roman Medvedev, Univ. Twente (Netherlands) . . . . . .[10329-148]

Features of the estimation of temperature distribution on the bead formed by the laser aided metal powder deposition, Yuri N. Zavalov, Alexander V. Dubrov, Fikret K. Mirzade, Vladimir D. Dubrov, Institute on Laser and Information Technologies (Russian Federation) . . . . . .[10329-149]

Optical fiber sensors measurement system and special fibers improvement, Michal Jelínek, Jan Hrabina, Miroslava Hola, Václav Hucl, Martin Cizek, Simon Rerucha, Josef Lazar, Bretislav Mikel, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic). . . . . .[10329-150]

Broadband interferometric characterisation of nano-positioning stages with sub-10 pm resolution, Zhi Li, Uwe Brand, Helmut Wolff, Ludger Koenders, Physikalisch-Technische Bundesanstalt (Germany); Andrew Yacoot, Prabowo Puranto, National Physical Lab. (United Kingdom) . . . . . .[10329-151]

Signal-to-noise ratio for mode-mode fiber interferometer, Oleg Kotov, Peter the Great Saint-Petersburg Polytechnic University (Russian Federation); Ivan Chapalo, Saint-Petersburg State Polytechnical Univ. (Russian Federation) . . . . . .[10329-153]

The design of the layout of faceted multi-channel electro-optical spatial coordinates measuring instrument for point-like bright objects, Vladislav Repin, Elena Gorbunova, Aleksandr Chertov, Valery V Korotaev, ITMO Univ. (Russian Federation) . . . . . .[10329-154]

Wide-angle solar-blind UV optical system for power transmission line monitoring, Andrey V. Obrezkov, JSC AstroSoft Development (Russian Federation) and S.I. Vavilov State Optical Institute (Russian Federation); Andrey Rodionov, Viktor Pisarev, Alexey N. Chivanov, Yuri P. Baranov, JSC AstroSoft Development (Russian Federation) . . . . . .[10329-155]

Analysis and 3D inspection system of drill holes in aeronautical surfaces, Ricardo Rubio Oliver, Luis Granero Montagud, Martín Sanz Sabater, Javier García Monreal, Vicente Micó Serrano, Univ. de València (Spain) . .[10329-156]

Measuring horizontal atmospheric turbulence at ground level from optical turbulence generator (OTG) over a 1D sensor, Omar J. Tíjaro Rojas, Yezid Torres Moreno, Univ. Industrial de Santander (Colombia) . . . . . .[10329-157]

Absolute measurement of surface figure of rotationally symmetrical aspheric surfaces, Wei-Cheng Lin, Instrument Technology Research Ctr. (Taiwan) . . . . . .[10329-158]

The analysis of methods to calculate the measurement error of coordinates for optical-electronic system for real-time position control of roof's supporting structure, Sergey V. Mikheev, Igor A. Koniakhin, Oleg Barsukov, ITMO Univ. (Russian Federation) . . . . . .[10329-159]

Superresolution imaging in spatially multiplexed interferometric microscopy by using time multiplexing, Vicente Micó Serrano, José Angel Picazo-Bueno, Univ. de València (Spain); Zeev Zalevsky, Bar-Ilan Univ. (Israel); Javier García, Carlos Ferreira, Univ. de València (Spain) . . . . . .[10329-160]

Water turbidity optical meter using optical fiber array for topographical distribution analysis, Kussay N. M. Al-Zubaidi, Mohamad Zubir Mat Jafri, Stephenie Yeoh, Univ. Sains Malaysia (Malaysia). . . . . .[10329-161]

Uncertainty analysis of optical components absorption coefficient measurement using an intra-cavity device, Baozhu Yan, Wenguang Liu, Qiong Zhou, Shaojun Du, Yi Yang, National Univ. of Defense Technology (China) . . . . . .[10329-162]

Invariant electro-optical system for deflection measurement of floating docks, Alexey A. Gorbachev, Anh Phuong Hoang, ITMO Univ. (Russian Federation) . . . . . .[10329-163]

Numerical analysis of nonlinear multimode interference waveguide as a refractive index sensor, Stephenie Yeoh, Kussay N. Mutter, Mohamad Zubir Mat Jafri, Univ. Sains Malaysia (Malaysia) . . . . . .[10329-165]

Investigation of the relative orientation of the system of optical sensors to monitor the technosphere objects, Andrey V. Petrochenko, Igor A. Konyakhin, ITMO Univ. (Russian Federation) . . . . . .[10329-166]

Evaluation of laser ablation crater relief by white light micro interferometer, Igor P. Gurov, Mikhail V. Volkov, Ekaterina V. Zhukova, Nikita Ivanov, Nikita Margaryants, Andrey Potemkin, Andrey Samokhvalov, Svetlana Shelygina, ITMO Univ. (Russian Federation). . . . . .[10329-167]

Relationship of parameters of optical equisignal zone system for providing constant static characteristics, Anton A. Maraev, Aleksandr N. Timofeev, ITMO Univ. (Russian Federation); Vadim F. Gusarov, Sergey V. Mednikov, Aleksandr A. Klimov, ITMO University (Russian Federation). . . . . .[10329-168]

Estimation of the particle concentration in hydraulic liquid by the in-line automatic particle counter based on the CMOS image sensor, Dmitriy V. Kornilin, Ilya A. Kudryavtsev, Samara Univ. (Russian Federation); Alison J McMillan, Ardeshir Osanlou, Ian Ratcliffe, Glyndwr University (United Kingdom). . . . . .[10329-169]

The research of the cross-links effect influence in the color matrix photodetector on an error of the air tract vertical temperature gradient determination, Ivan S. Nekrylov, Maksim A. Kleshchenok, Aleksandr N. Timofeev, Elena Sycheva, Vadim Gusarov, ITMO Univ. (Russian Federation) . . . . . .[10329-170]

Parameter optimization of measuring and control elements in the monitoring systems of complex technical objects, Ivan S. Nekrylov, Valery V. Korotaev, Anastasia Blokhina, Maksim A. Kleshchenok, ITMO Univ. (Russian Federation) . . . . . .[10329-171]

Advanced defect classification (ADC) by optical metrology, Peter van der Walle, TNO (Netherlands); Esther Kramer, TNO (Netherlands) and Technische Univ. Delft (Netherlands); Jacques C. J. van der Donck, Wouter F. W. Mulckhuyse, Jacqueline van Veldhoven, Loek Nijsten, Felipe A. Bernal Arango, Anton de Jong, Christiaan L. Hollemans, Elfi van Zeijl, Helma Spruit, TNO (Netherlands); Paul F. A. Alkemade, Silvania Pereira, Technische Univ. Delft (Netherlands); Diederik J. Maas, TNO (Netherlands). . . . . .[10329-172]

Effects of the density and homogeneity in NIRS crop moisture estimation, Nicola Lenzini, Luigi Rovati, Univ. degli Studi di Modena e Reggio Emilia (Italy); Luca Ferrari, CNH Industrial Italia (Italy) . . . . . .[10329-173]

System testing for the Fresnel-lens-based optical concentrator for photovoltaic (CPV) solar energy harvesting, Anuar B. Beltran Gonzalez, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Marija Strojnik Scholl, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico); Juan Milton Garduno, Gautier Veroone, Mixbaal SA de CV (Mexico). . . . . .[10329-174]

Direct fabrication of polymer micro-lens array, Sara Coppola, Vito Pagliarulo, Veronica Vespini, Giuseppe Nasti, Federico Olivieri, Simonetta Grilli, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10329-175]

Optical fibre-based reflective displacement sensor: computer modelling and application to impact detection in aeronautical structures, Iker García, Gaizaka Durana, Gotzon Aldabaldetreku, Joseba Zubia, I. Saez-Ocariz, Josu Amorebieta, Univ. del País Vasco (Spain). . . . . .[10329-176]

Characterization of laser damage performance of fused silica using photothermal absorption technique, Wen Wan, Feng Shi, Yifan Dai, Xiaoqiang Peng, National Univ. of Defense Technology (China). . . .[10329-177]

Compensation of optical system distortion and image perspective deformations for the projection lens, Anastasiia Burtseva, Kseniia V. Ezhova, Oleg V Trifanov, ITMO Univ. (Russian Federation) . . . . . .[10329-178]

A flexible 3D laser scanning system using a robotic arm, Zixuan Fei, Xi'an Jiaotong Univ. (China); Xiang Zhou, Xi'an Jiaotong Univ. (China); Xiaofei Gao, Xi'an Jiaotong Univ. (China); Guanliang Zhang, Xi'an Jiaotong Univ. (China) . . . . . .[10329-180]

A high-performance fringe pattern generation method for fringe projection profilometry, Tao Yang, Xi'an Jiaotong Univ. (China); Huanhuan Li, Xi'an Jiaotong Univ. (China); Xiang Zhou, Yuqin Li, Jiayu Guo, Xi'an Jiaotong Univ. (China); Xiaofei Gao, Xi'an Jiaotong Univ. (China). . . . . .[10329-181]

A high-speed full-field profilometry with coded laser strips projection, Guanliang Zhang, Xiang Zhou, Rui Jin, Chang da Xu, Dong Li, Xi'an Jiaotong Univ. (China) . . . . . .[10329-182]

A hybrid structured-light measurement using a laser projector

, Jiayu Guo, Xiang Zhou, Dong Li, Chao Wang, Zixuan Fei, Huanhuan Li, Xi'an Jiaotong Univ. (China) . . . . . .[10329-183]

SESSION 7

LOCATION: 14C . . . . . TUE 14:10 TO 15:30

Fringe Projection II

Session Chair: **Eberhard Manske,** Technische Univ. Ilmenau (Germany)

14:10: **Suppression of contrast-related artefacts in phase-measuring structured light techniques**, Jan Burke, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Liang Zhong, Karlsruher Institut für Technologie (Germany) . . . . . .[10329-28]

14:30: **3D geometry measurement of hot cylindric specimen using structured light**, Lorenz Quentin, Rüdiger Beermann, Andreas Pösch, Eduard Reithmeier, Markus Kästner, Leibniz Univ. Hannover (Germany) . . . .[10329-29]

14:50: **Phase retrieval for high-speed 3D measurement using binary patterns with projector defocusing**, Dongliang Zheng, Southeast Univ. (China); Qian Kemao, Nanyang Technological Univ. (Singapore); Feipeng Da, Southeast Univ. (China); Hock Soon Seah, Nanyang Technological Univ. (Singapore) . . . . . .[10329-31]

15:10: **Experimental comparison of photogrammetry for additive manufactured parts with and without laser speckle projection**, Danny Sims-Waterhouse, Patrick Bointon, Samanta Piano, Richard K. Leach, The Univ. of Nottingham (United Kingdom) . . . . . .[10329-76]

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

SESSION 8

LOCATION: 14C . . . . . TUE 16:00 TO 18:00

Special Session: Spectroscopic Techniques in Industrial and Astronomical Applications

Session Chair: **Philipp Huke,** Georg-August-Univ. Göttingen (Germany)

16:00: **Comparison of astrophysical Fabry-Perots with respect to the requirements of HIRES**, Sebastian Schäfer, Philipp Huke, Ansgar Reiners, Georg-August-Univ. Göttingen (Germany); Francesco Pepe, Marco Riva, Bruno Chazelas, Observatoire de Genève (Switzerland); Piotr Maslowski, Grzegorz Kowzan, Nicolaus Copernicus Univ. (Poland). . . . . .[10329-32]

16:20: **Comparison of astrophysical laser frequency combs with respect to the requirements of HIRES**, Jake M. Charsley, Richard A. McCracken, Derryck T. Reid, Heriot-Watt Univ. (United Kingdom); Grzegorz Kowzan, Piotr Maslowski, Nicolaus Copernicus Univ. (Poland); Ansgar Reiners, Philipp Huke, Georg-August-Univ. Göttingen (Germany) . . . . . .[10329-33]

16:40: **The end-to-end simulator for the E-ELT HIRES high resolution spectrograph**, Matteo Genoni, Marco Landoni, Giorgio Pariani, Marco Riva, INAF - Osservatorio Astronomico di Brera (Italy); Elena Maso

on, Paolo Di Marcantonio, INAF - Osservatorio Astronomico di Trieste (Italy); Karen Disseau, Georg-August-Univ. Göttingen (Germany); Igor Di Varano, Leibniz-Institut für Astrophysik Potsdam (Germany); Oscar Gonzalez, UK Astronomy Technology Ctr. (United Kingdom); Phillipp Huke, Georg-August-Univ. Göttingen (Germany); Gianluca Li Causi, INAF - Osservatorio Astronomico di Roma (Italy) . . . . . .[10329-34]

17:00: **Calibration of astronomical infra-red spectrographs: from VLT/CRIRES to the E-ELT**, Ulf Seemann, Georg-August-Univ. Göttingen (Germany); Paul Bristow, Claudio Cumani, Reinhold J. Dorn, European Southern Observatory (Germany); Roman Follert, Artie P. Hatzes, Thüringer Landessternwarte Tautenburg (Germany); Ulrike Heiter, Uppsala Univ. (Sweden); Renate Hinterschuster, Derek J. Ives, Yves Jung, Barbara Klein, European Southern Observatory (Germany); Alexis Lavail, Uppsala Univ. (Sweden); Jean-Louis Lizon, European Southern Observatory (Germany); Thomas Marquart, Uppsala Univ. (Sweden); Ignacio Molina-Conde, European Southern Observatory (Germany); Ernesto Oliva, INAF - Osservatorio Astrofisico di Arcetri (Italy); Jérôme Paufique, European Southern Observatory (Germany); Nikolai E. Piskunov, Uppsala Univ. (Sweden); Ansgar Reiners, Georg-August-Univ. Göttingen (Germany); Eric Stempels, Uppsala Univ. (Sweden) .[10329-35]

17:20: **Atomic layer sensitive in-situ plasma etch depth control with reflectance anisotropy spectroscopy (RAS)**, Christoph Döring, Ann-Kathrin Kleinschmidt, Lars Barzen, Johannes Strassner, Henning Fouckhardt, Technische Univ. Kaiserslautern (Germany) . . . . . .[10329-36]

17:40: **Photo-vibrational spectroscopy using quantum cascade laser and laser Doppler vibrometer**, Huan Liu, Qi Hu, Jiecheng Xie, Yu Fu, Nanyang Technological Univ. (Singapore) . . . . . .[10329-37]

WEDNESDAY 28 JUNE

SESSION 9

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

High-Resolution Profiling I

Session Chair: **Paul C. Montgomery,** Univ. de Strasbourg (France)

8:10: **Three-dimensional Dammann confocal microscopy** *(Invited Paper)*, Changhe Zhou, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . .[10329-38]

8:40: **Optical inspection of hidden MEMS structures**, Johann Krauter, Marc Gronle, Institut für Technische Optik (Germany); Wolfgang Osten, Univ. Stuttgart (Germany) . . . . . .[10329-39]

9:00: **Confocal unrolled areal measurements of cylindrical surfaces**, Aitor Matilla Ayala, Carlos Bermudez, Jordi Mariné, David Martinez, Sensofar-Tech, S.L. (Spain); Cristina Cadevall, Roger Artigas, Sensofar-Tech, S.L. (Spain) and UPC-CD6 (Spain) . . . . . .[10329-40]

9:20: **Transfer characteristics of optical profilers with respect to rectangular edge and step height measurement**, Weichang Xie, Sebastian Hagemeier, Univ. Kassel (Germany); Jörg Bischoff, Rostyslav Mastylo, Eberhard Manske, Technische Univ. Ilmenau (Germany); Peter Lehmann, Univ. Kassel (Germany) . . . . . .[10329-41]

9:40: **Focus-variation microscopy for measurement of surface roughness and autocorrelation length**, Erich N. Grossman, National Institute of Standards and Technology (USA) . . . . . .[10329-42]

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

OPTICAL METROLOGY/DIGITAL OPTICAL TECHNOLOGIES 2017 PLENARY SESSION

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

Metasurface Diffractive Optics

Federico Capasso, Harvard Univ. (USA)

For details, please see page 3 or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

SESSION 10

LOCATION: 14C . . . . . .WED 11:30 TO 13:00

High-Resolution Profiling II

Session Chair: **Juergen W. Czarske,** TU Dresden (Germany)

11:30: **Sub-diffraction surface topography measurement using a microsphere-assisted Linnik interferometer** *(Invited Paper)*, Paul C. Montgomery, Sylvain Lecler, Audrey Leong-Hoï, Univ. de Strasbourg (France); Stéphane Perrin, Pierre Pfeiffer, Univ. de Strasbourg (France) . . . . . .[10329-43]

12:00: **Measurement, certification and use of step-height calibration specimens in optical metrology**, Peter J. de Groot, Danette Fitzgerald, Zygo Corporation (USA) . . . . . .[10329-44]

12:20: **Surface profile measurement by using the integrated Linnik WLSI and confocal microscope system**, Wei-Chung Wang, Ming-Hsing Shen, National Tsing Hua Univ. (Taiwan); Chi-Hung Hwang, Instrument Technology Research Ctr. (Taiwan); Yun-Ting Yu, Tzu-Fong Wang, National Tsing Hua Univ. (Taiwan) . . . . . .[10329-45]

12:40: **Super-resolution photonic nanojet interferometry: photonic nanojet interaction with polymer sample**, Maria Gritsevich, Göran Maconi, Anton Nolvi, Ivan Kassamakov, Antti Penttilä, Karri Muinonen, Edward Hæggström, Univ. of Helsinki (Finland) . . . . . .[10329-119]

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

SESSION 11

LOCATION: SAAL 21 . . . . . WED 14:00 TO 15:30

Joint Session I: High-Precision Measurement of Optical Components and Systems

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

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

14:00: **Light scattering characterization of high-performance optical components – influence of roughness, defects, and coatings** *(Invited Paper)*, Sven Schröder, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . . .[10329-200]

14:30: **Combination of a fast white-light interferometer with a phase shifting interferometric line sensor for form measurements of precision components**, Sören Laubach, Gerd Ehret, Physikalisch-Technische Bundesanstalt (Germany); Jörg Riebling, Peter Lehmann, Univ. Kassel (Germany) . . . . . .[10329-47]

14:50: **Wide-ranging roughness analysis of optical surfaces**, Nadja Feide, Luisa Coriand, Sven Schröder, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany). . . . . .[10329-201]

15:10: **Birefringence measurement in complex optical systems**, Holger Knell, Leica Microsystems GmbH (Germany); Hans-Martin Heuck, Leica Microsystems CMS GmbH (Germany) . . . . . .[10329-48]

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

SESSION 12

LOCATION: SAAL 21 . . . . . WED 16:00 TO 18:10

Joint Session II: High-Precision Measurement of Optical Components and Systems

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

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

16:00: **Dynamic interferometry: metrology of space optics and structures** *(Invited Paper)*, James E. Millerd, Michael north-morris, 4D Technology Corp. (USA) . . . . . .[10329-49]

16:30: **In situ laser polishing optimization method: control of LASer Surface Optimisation (C-Lasso)**, Rolf Rascher, Hochschule Deggendorf Technologiecampus Teisnach (Germany); Christian Vogt, Technische Hochschule Deggendorf (Germany); Oliver W. Fähnle, FISBA AG (Switzerland) . . . . . .[10329-202]

16:50: **Preliminary results of a new proposal for objective human independent striae measurement**, Steffen Reichel, Pforzheim Univ. (Germany) and Hochschule Darmstadt (Germany); Peter Hartmann, Uwe Petzold, SCHOTT AG (Germany); Christina Lempa, Eckelmann AG (Germany) . . . . . .[10329-50]

17:10: **Wavefront evaluation method based on imaging performance: relative wavefront gradient deviation**, Bin Xuan, Jingjiang Xie, Changchun Institute of Optics, Fine Mechanics and Physics (China) . . . . . .[10329-203]

17:30: **Development of metrology for freeform optics in reflection mode**, Dali R. Burada, Kamal K. Pant, Vinod Mishra, Indian Institute of Technology Delhi (India); Mohamed Bichra, Technische Univ. Ilmenau (Germany); Gufran S. Khan, Indian Institute of Technology Delhi (India); Stefan Sinzinger, Technische Univ. Ilmenau (Germany); Chandra Shakher, Indian Institute of Technology Delhi (India). . . . . .[10329-51]

17:50: **Metrology for freeform and wafer level optics by UA3P**, Dieter Ramm, Tomofumi Morishita, Panasonic Automotive & Industrial Systems Europe GmbH (Germany); Keiji Kubo, Panasonic Factory Solutions Co., Ltd. (Japan)[10329-204]

THURSDAY 29 JUNE

SESSION 13

LOCATION: 14C . . . . . THU 8:20 TO 10:00

Speckle Metrology

Session Chair: **Sen Han,** Univ. of Shanghai for Science and Technology (China)

8:20: **Deformation measurements by ESPI of the surface of a heated mirror and comparison with numerical model**, Fabian Languy, Jean-François Vandenrijt, Ctr. Spatial de Liège (Belgium); Philippe Saint-Georges, Open Engineering S.A. (Belgium); Marc P. Georges, Ctr. Spatial de Liège (Belgium) . . . . . .[10329-52]

8:40: **Reduction of phase singularities in a speckle Michelson setup**, Klaus Mantel, Max-Planck-Institut für die Physik des Lichts (Germany); Vanusch Nercissian, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany)[10329-53]

9:00: **Speckle-interferometric measurement system of 3D deformation to obtain thickness changes of thin specimen under tensile loads**, Robert Kowarsch, Jiajun Zhang, Carmen Sguazzo, Stefan Hartmann, Christian Rembe, Technische Univ. Clausthal (Germany) . . . . . .[10329-54]

9:20: **Uncertainty of scattered light roughness measurements based on speckle correlation methods**, Stefan Patzelt, Dirk Stöbener, Gerald Ströbel, Andreas Fischer, Bremer Institut für Messtechnik, Automatisierung und Qualitätswissenschaft (BIMAQ) (Germany) . . . . . .[10329-55]

9:40: **Pre-treatment for preventing degradation of measurement accuracy by speckle noise in speckle interferometry**, Yasuhiko Arai, Kansai Univ. (Japan) . . . . . .[10329-56]

Coffee Break . . . . . Thu 10:00 to 10:20

SESSION 14

LOCATION: 14C . . . . . THU 10:20 TO 12:30

In-situ and Nondestructive Testing I

Session Chair: **Changhe Zhou,** Shanghai Institute of Optics and Fine Mechanics (China)

10:20: **Optical residual stress measurement in TFT-LCD panels** *(Invited Paper)*, Wei-Chung Wang, Po-Chi Sung, National Tsing Hua Univ. (Taiwan) . . . . . .[10329-57]

10:50: **Calibration of the incident beam in a reflective topography measurement from an unknown surface**, Tobias Binkele, David Hilbig, Friedrich Fleischmann, Thomas Henning, Hochschule Bremen Univ. of Applied Sciences (Germany) . . . . . .[10329-58]

11:10: **Error influences of the shear element in interferometry for the form characterization of optics**, Jan-Hendrik Hagemann, Physikalisch-Technische Bundesanstalt (Germany); Claas Falldorf, Bremer Institut für angewandte Strahltechnik GmbH (Germany); Gerd Ehret, Physikalisch-Technische Bundesanstalt (Germany); Ralf B. Bergmann, Bremer Institut für angewandte Strahltechnik GmbH (Germany) . . . . . .[10329-59]

11:30: **Automated NDT in a production environment using Dantec dynamics' robotic shearography**, Georges-Stephane Crabus, Dantec Dynamics GmbH (Germany) . . . . . .[10329-60]

11:50: **An endoscophic shearography system with radial sensitivity for inner inspection of adhesion faults in composite material pipes**, Mauro E. Benedet, Fabiano J. Macedo, Analucia V. Fantin, Daniel P. Willemann, F. A. A. Silva, Univ. Federal de Santa Catarina (Brazil); S. D. Soares, CENPES - PETROBRAS (Brazil); Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil) . . . . . .[10329-61]

12:10: **Bulk strain solitons as a tool for determination of the third order elastic moduli of composite materials**, Irina V. Semenova, Andrey V. Belashov, Ioffe Institute (Russian Federation); Fedor E. Garbuzov, Ioffe Institute (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation); Alexander M. Samsonov, Ioffe Institute (Russian Federation); Alexander A. Semenov, Ioffe Institute (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation) . . . . . .[10329-62]

Lunch Break . . . . . Thu 12:30 to 13:30

SESSION 15

LOCATION: 14C . . . . . THU 13:30 TO 15:40

In-situ and Nondestructive Testing II

Session Chair: **Wei-Chung Wang,** National Tsing Hua Univ. (Taiwan)

13:30: **Fiber Bragg grating sensors in harsh environments: considerations and industrial monitoring applications** *(Invited Paper)*, Alexis Mendez, Micron Optics, Inc. (USA) . . . . . .[10329-63]

14:00: **Measurement uncertainty budget of an interferometric flow velocity sensor**, Mike Bermuske, Lars Büttner, Jürgen W. Czarske, TU Dresden (Germany) . . . . . .[10329-64]

14:20: **Laser speckle velocimetry for robot manufacturing**, Thomas O. H. Charrett, Yashwanth K. Bandari, Florent Michel, Jialuo Ding, Stewart W. Williams, Ralph P. Tatam, Cranfield Univ. (United Kingdom) . . . . . .[10329-65]

14:40: **Non-invasive seedingless measurements of the flame transfer function using high-speed camera-based laser vibrometry**, Johannes Gürtler, TU Dresden (Germany); Felix Greiffenhagen, Jakob Woisetschläger, Technische Univ. Graz (Austria); Daniel Haufe, Jürgen W. Czarske, TU Dresden (Germany) . . . . . .[10329-66]

15:00: **Optical rotor-blade deformation measurements using a rotating camera system**, Fritz Boden, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (Germany); Boleslaw Stasicki, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Krzysztof Ludwikowski, HARDsoft Microprocessor Systems (Poland); Dieter Roth, Airbus Helicopters (Germany) . . . . . .[10329-67]

15:20: **Application of a multilayer surface approach for the estimation of material-dependent optical properties for ellipso-height-topometry**, Abdullah Karatas, Matthias Eifler, Jörg Seewig, Technische Univ. Kaiserslautern (Germany) . . . . . .[10329-46]

Coffee Break . . . . . Thu 15:40 to 16:00

SESSION 16

LOCATION: 14C . . . . . THU 16:00 TO 17:20

In-situ and Nondestructive Testing III

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

16:00: **In-situ measurement with deflectometric acquisition of large optical surfaces DaOS using vignetting field stop VFS procedure**, Engelbert Hofbauer, Technische Hochschule Deggendorf (Germany) and Hofbauer Optik Mess-&Prüftechnik (Germany); Rolf Rascher, Hochschule Deggendorf Technologiecampus Teisnach (Germany); Thomas Münch, STOCK Konstruktion GmbH (Germany); Jan-Peter P. Richters, Berliner Glas KGaA Herbert Kubatz GmbH & Co. (Germany). . . . . .[10329-69]

16:20: **3D interferometric shape measurement technique using coherent fiber bundles**, Hao Zhang, Robert Kuschmierz, Jürgen W. Czarske, TU Dresden (Germany) . . . . . .[10329-70]

16:40: **Interferometric fibre-optic curvature sensing for structural, directional vibration measurements**, Thomas Kissinger, Edmon Chehura, Stephen W. James, Ralph P. Tatam, Cranfield Univ. (United Kingdom) . . . . . .[10329-71]

17:00: **Subpixel edge estimation with lens aberrations compensation based on the iterative image simulation for high-precision thermal expansion measurements of solids**, Fedor M. Inochkin, Sergey K. Kruglov, Saint Petersburg State Univ. (Russian Federation); Igor G. Bronshtein, ITMO Univ. (Russian Federation); Tatiana A. Kompan, D.I. Mendeleyev Institute for Metrology (Russian Federation); Sergey V. Kondratjev, Alexander S. Korenev, Nickolay F. Pukhov, D.I.Mendeleyev Institute for Metrology (Russian Federation) . . . . . .[10329-72]

CONFERENCE 10330 · LOCATION: 12A

Tuesday - Thursday 27–29 June 2017 • Proceedings of SPIE Vol. 10330

Modeling Aspects in Optical Metrology

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 (USA)

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 fur 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 26 JUNE

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION
LOCATION: SAAL 1, ICM . . . . . MON 10:00 TO 11:00

Putting a Spin on Photons

Jörg Wachtrup, Univ. of Stuttgart (Germany)

For details, please see page 3, or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

LOCATION: 12A . . . . . 11:30 TO 11:40

Welcome and Introduction

SESSION 1

LOCATION: 12A . . . . . MON 11:40 TO 12:40

Light Scattering

Session Chair: **Stefanie Kroker,** Physikalisch-Technische Bundesanstalt (Germany)

11:40: **Simulating propagation of coherent light in random media using the Fredholm type integral equation**, Maciej Kraszewski, Jerzy Pluciński, Gdansk Univ. of Technology (Poland) . . . . . .[10330-1]

12:00: **Study of pure liquids using the analysis of dynamic speckle: model and natural experiments**, Valentyna Pobiedina, Andrey V. Yakunov, Taras Shevchenko National Univ. of Kyiv (Ukraine) . . . . . .[10330-2]

12:20: **Quantifying parameter uncertainties in optical scatterometry using Bayesian inversion**, Martin Hammerschmidt, JCMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany); Martin Weiser, Zuse Institute Berlin (ZIB) (Germany); Xavier Garcia Santiago, JCMwave GmbH (Germany) and Karlsruhe Institute of Technology (Germany); Lin Zschiedrich, JCMwave GmbH (Germany); Bernd Bodermann, PTB (Germany); Sven Burger, JCMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany) . . . . . .[10330-3]

Lunch Break . . . . . .Mon 12:40 to 14:10

SESSION 2

LOCATION: 12A . . . . . MON 14:10 TO 16:00

Optical Systems

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

14:10: **Fiber-based DUV to NIR light source: fundamental concepts and applications in optical metrology** *(Invited Paper)*, Patrick Uebel, Sebastian Bauerschmidt, R. Christian Martens-Biersach, Ralf Keding, Max-Planck-Institut für die Physik des Lichts (Germany); Hendrik Sabert, ultralumina AG (Germany); Philip St. John Russell, Max-Planck-Institut für die Physik des Lichts (Germany) . . . . . .[10330-5]

14:40: **Combined use of a priori data for fast system self-calibration of a non-rigid multi-camera fringe projection system**, Petros I. Stavroulakis, Shuxiao Chen, Danny Sims-Waterhouse, Samanta Piano, Nicholas Southon, Patrick Bointon, Richard Leach, The Univ. of Nottingham (United Kingdom) . . . . . .[10330-6]

15:00: **Metrology and quality assurance for European XFEL long flat mirrors installation**, Idoia Freijo-Martín, Maurizio Vannoni, Harald Sinn, European XFEL GmbH (Germany). . . . . .[10330-7]

15:20: **Fiber emulator for the performance simulation of the fiber-slit spectrograph HIRES**, Karen Disseau, Philipp Huke, Ansgar Reiners, Georg-August-Univ. Göttingen (Germany); Ana B. Fragoso Lopez, Instituto de Astrofísica de Canarias (Spain); Matteo Genoni, Marco Landoni, INAF - Osservatorio Astronomico di Brera (Italy) . . . . . .[10330-8]

15:40: **Optical design of system for a lightship**, Maxim Chirkov, Helen A. Tsyganok, ITMO Univ. (Russian Federation) . . . . . .[10330-9]

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

SESSION 3

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

Mueller Polarimetry

Session Chair: **Poul-Erik Hansen,** Danish Fundamental Metrology Institut (Denmark)

16:30: **Experimental light scattering by small particles: first results with a novel Mueller matrix scatterometer**, Antti Penttilä, Göran Maconi, Ivan Kassamakov, Maria Gritsevich, Petteri Helander, Tuomas Puranen, Edward Hæggström, Univ. of Helsinki (Finland); Karri Muinonen, Univ. of Helsinki (Finland) and Finnish Geospatial Research Institute (Finland). . . . . .[10330-10]

16:50: **B-spline parameterization of the dielectric function and information criteria: the craft of non-overfitting**, Dmitriy V. Likhachev, GLOBALFOUNDRIES Dresden Module One LLC & Co. KG (Germany) . . . . . .[10330-11]

17:10: **Optical and mechanical architecture for the E-ELT HIRES polarimeter**, Igor Di Varano, Klaus G. Strassmeier, Manfred Woche, Michael Weber, Leibniz-Institut für Astrophysik Potsdam (Germany); Uwe Laux, Thüringer Landessternwarte Tautenburg (Germany); Shu Yuan, Yunnan Observatories (China); Marco Riva, INAF - Osservatorio Astronomico di Brera (Italy); Paolo Di Marcantonio, INAF - Osservatorio Astronomico di Trieste (Italy); Marco Landoni, Matteo Genoni, INAF - Osservatorio Astronomico di Brera (Italy); Gianluca Li Causi, INAF - Osservatorio Astronomico di Roma (Italy); Elena Mason, INAF - Osservatorio Astronomico di Trieste (Italy); Stefano Covino, INAF - Osservatorio Astronomico di Brera (Italy). . . . . .[10330-12]

TUESDAY 27 JUNE

SESSION 4

LOCATION: 12A . . . . . TUE 8:50 TO 10:00

Interferometry and Phase I

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

8:50: **Phase retrieval with tunable phase transfer function based on the transport of intensity equation** *(Invited Paper)*, Juan Martínez-Carranza, P. Stepien, Tomasz Kozacki, Warsaw Univ. of Technology (Poland) . . .[10330-13]

9:20: **Experimental measurement and numerical analysis of group velocity dispersion in cladding modes of an endlessly single-mode photonic crystal fiber**, Tobias Baselt, Christopher Taudt, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer IWS Dresden (Germany) and TU Dresden (Germany); Bryan L. Nelsen, Westsächsische Hochschule Zwickau (Germany); Peter Hartmann, Fraunhofer IWS Dresden (Germany) and Westsächsische Hochschule Zwickau (Germany); Andrés-Fabián Lasagni, TU Dresden (Germany) and Fraunhofer IWS Dresden (Germany). . . . . .[10330-14]

9:40: **Study of the optical crosstalk in a heterodyne displacement gauge with cancelable circuit**, Alberto Donazzan, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. degli Studi di Padova (Italy) and CNR-IFN Padova (Italy); Giampiero Naletto, Univ. degli Studi di Padova (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Maria G. Pelizzo, CNR-IFN Padova (Italy) and Istituto Nazionale di Fisica Nucleare (Italy). . . . . .[10330-15]

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

SESSION 5

LOCATION: 12A . . . . . TUE 10:30 TO 11:30

Interferometry and Phase II

Session Chair: **Daniel Claus,** Univ. Stuttgart (Germany)

10:30: **Digital micromirror device as amplitude diffuser for multiple-plane phase retrieval**, Timothy Joseph T. Abregana, Nathaniel P. Hermosa II, National Institute of Physics, Univ. of the Philippines (Philippines); Percival F. Almoro, Univ. of the Philippines (Philippines) . . . . . .[10330-17]

10:50: **A flexible, simple telecentric three dimensional measurement system**, Tong Chen, Jindong Tian, Yong Tian, Jianmei Wu, Dong Li, Shenzhen Univ. (China) . . . . . .[10330-18]

11:10: **Optofluidic in-plane Mach-Zehnder interferometer based on the liquid core/liquid cladding waveguides for refractive-Index measurements**, Mohammadreza Oraie, Hamid Latifi, Shahid Beheshti Univ. (Iran, Islamic Republic of) . . . . . .[10330-19]

Lunch Break . . . . . Tue 11:30 to 13:30

SESSION 6

LOCATION: 12A . . . . . TUE 13:30 TO 15:20

Scatterometry

Session Chair: **Jörg Bischoff,** Technische Univ. Ilmenau (Germany)

13:30: **Modeling surface imperfections in thin films and nanostructured surfaces** *(Invited Paper)*, Poul-Erik Hansen, Jonas S. Madsen, Søren Jensen, Morten H. Madsen, Danish Fundamental Metrology Institut (Denmark); Mirza Karamehmedovic, Technical Univ. of Denmark (Denmark). . . . . .[10330-20]

14:00: **In-line measuring method for periodical sub-wavelength nanostructures**, Gabriela Alexe, Andreas Tausendfreund, Dirk Stöbener, Andreas Fischer, Bremer Institut für Messtechnik, Automatisierung und Qualitätswissenschaft (BIMAQ) (Germany) . . . . . .[10330-21]

14:20: **Metrology of nanoscale grating structures by optical scatterometry**, Matthias Wurm, Alexander Diener, Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany) . . . . . .[10330-22]

14:40: **Advancing optical metrology to enable atom-scale technology**, Richard M. Silver, Bryan M. Barnes, Hui Zhou, Mark-Alexander Henn, Martin Y. Sohn, András E. Vladár, National Institute of Standards and Technology (USA) . . . . . .[10330-23]

15:00: TBA

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

SESSION 7

LOCATION: 12A . . . . . TUE 16:00 TO 17:50

Surface Topography and Form

Session Chair: **Richard M. Silver,** National Institute of Standards and Technology (USA)

16:00: **Numerical investigations of the potential for laser focus sensors in micrometrology** *(Invited Paper)*, Jörg Bischoff, Rostyslav Mastylo, Eberhard Manske, Technische Univ. Ilmenau (Germany) . . . . . .[10330-25]

16:30: **Measuring shape of a mirror with a moving camera**, Alexey V. Pak, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10330-26]

16:50: **Model-based uncertainty evaluation for absolute form metrology**, Haiyang Quan, Xi Hou, Fan Wu, Weihong Song, Institute of Optics and Electronics (China). . . . . .[10330-27]

17:10: **Evaluation of a human corneal surface with the null-screen method**, Victor de Emanuel Armengol-Cruz, Manuel Campos-García, Cesar Cossio-Guerrero, Univ. Nacional Autónoma de México (Mexico) . . . . . .[10330-28]

17:30: **Evaluation of the shape of a parabolic trough solar collector with flat null-screens**, Manuel Campos-García, Andrés Peña-Conzuelo, José Rufino Díaz-Uribe, Univ. Nacional Autónoma de México (Mexico). . .[10330-29]

WEDNESDAY 28 JUNE

SESSION 8

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

Gratings: LER and Polarisation

Session Chair: **Martin Hammerschmidt,** Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany)

8:50: **Simulation of the influence of line edge roughness on the performance of deep ultraviolet wire grid polarizers** *(Invited Paper)*, Thomas Siefke, Carol B. Rojas Hurtado, Johannes Dickmann, Physikalisch-Technische Bundesanstalt (Germany); Martin Heusinger, Institute of Applied Physics (Germany); Stefanie Kroker, Physikalisch-Technische Bundesanstalt (Germany) and Technische Univ. Braunschweig (Germany). . . . . .[10330-30]

9:20: **Structural information and performance prediction of nano-optical wire grid polarizers based on guided mode resonances**, Carol B. Rojas Hurtado, Physikalisch-Technische Bundesanstalt (Germany); Thomas Siefke, Physikalisch-Technische Bundesanstalt (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Johannes Dickmann, Stefanie Kroker, Physikalisch-Technische Bundesanstalt (Germany). . . . . .[10330-31]

9:40: **Fingerprinting the type of line edge roughness**, Analia Fernandez Herrero, Mika Pflüger, Frank Scholze, Victor Soltwisch, Physikalisch-Technische Bundesanstalt (Germany). . . . . .[10330-32]

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

OPTICAL METROLOGY/DIGITAL OPTICAL TECHNOLOGIES 2017 PLENARY SESSION

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

Metasurface Diffractive Optics

Federico Capasso, Harvard Univ. (USA)

For details, please see page 3 or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

POSTERS—WEDNESDAY

LOCATION: ICM FOYER . . . . . WED 12:40 TO 13:50

Conference attendees are invited to attend the Optical Metrology Poster Session 2 on Wednesday. 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 12:40 through 13:50 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Simulation and considering in the experimental data of polarization effects in optical measuring instruments, Anna V. Trushkina, Victoria A. Ryzhova, Aleksandr S. Vasilev, ITMO Univ. (Russian Federation) . . . . . .[10330-38]

SESSION 9

LOCATION: 12A . . . . . WED 13:50 TO 15:30

Microscopy and Imaging

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

13:50: **Role of coherence in microsphere-assisted nanoscopy** *(Invited Paper)*, Stéphane Perrin, Sylvain Lecler, Audrey Leong-Hoi, Paul Montgomery, ICube (France) . . . . . .[10330-33]

14:20: **Optimizing image-based patterned defect inspection through FDTD simulations at multiple ultraviolet wavelengths** *(Invited Paper)*, Bryan M. Barnes, Hui Zhou, Mark-Alexander Henn, Martin Y Sohn, Richard M. Silver, National Institute of Standards and Technology (USA). . . . . .[10330-34]

14:50: **Optical vortex microscope with the simple phase object: theoretical model and its experimental verification**, Agnieszka Popiolek-Masajada, Jan Masajada, Piotr Kurzynowski, Wroclaw Univ. of Science and Technology (Poland) . . . . . .[10330-35]

15:10: **Nanofabrication results of a novel cascaded plasmonic superlens: lessons learned**, Huiyu Li, Liwei Fu, Karsten Frenner, Wolfgang Osten, Institut für Technische Optik (Germany) . . . . . .[10330-36]

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

JOINT SESSION

LOCATION: 12A . . . . . WED 16:00 TO 17:30

SPIE/OM/EQEC: Light and Structure

Session Chair: **Timothy D. Drysdale,** The Open Univ. (United Kingdom)

Joint Session: SPIE Optical Metrology - CLEO EQEC 2017

16:00: **Discontinuous-Galerkin methods for the accurate modelling of photonic systems**, Kurt Busch, Humboldt-Univ. zu Berlin (Germany) . . . . . .[10330-100]

16:30: **Comparison of five numerical methods for computing quality factors and resonance wavelengths in photonic crystal membrane cavities**, Niels Gregersen, Technical Univ. of Denmark (Denmark) .[10330-101]

16:45: **Emergence of long-range phase coherence in nonlocal nonlinear media**, Adrien Fusaro, CNRS (France) . . . . . .[10330-102]

17:00: **Do photons push or pull a boundary?** *(Invited Paper)*, Shubo Wang, Hong Kong Univ. of Science and Technology (Hong Kong, China) .[10330-103]

CONFERENCE 10331 · LOCATION: 12B

Wednesday - Thursday 28–29 June 2017 • Proceedings of SPIE Vol. 10331

O3A: Optics for Arts, Architecture, and Archaeology

Conference Chairs: **Luca Pezzati,** Istituto Nazionale di Ottica-CNR (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 (USA); **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); **Vincent Detalle,** Centre de Recherche et de Restauration des Musées de France (C2RMF) (France); **John K. Delaney,** National Gallery of Art (USA); **Raffaella E. M. Fontana,** Istituto Nazionale di Ottica (Italy); **Roger Groves,** Technische Univ. Delft (Netherlands); **Igor P. Gurov,** ITMO Univ. (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,** International Institute for Conservation (United Kingdom); **Robert Sitnik,** Warsaw Univ. of Technology (Poland); **Heike Stege,** Doerner Institut (Germany); **Vivi Tornari,** Foundation for Research and Technology-Hellas (Greece)

WEDNESDAY 28 JUNE

LOCATION: 12B . . . . . 8:45 TO 8:50

Opening Remarks

SESSION 1

LOCATION: 12B . . . . . WED 8:50 TO 10:00

Integrated Techniques and Case Studies

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

8:50: **A novel macroscanner imaging system for collection of multimodal hyperspectral image cubes of Old Master paintings** *(Invited Paper)*, John K. Delaney, D. Conover, Kathryn A. Dooley, Lisha Glinsman, Suzanne Lomax, National Gallery of Art (USA); Murray H. Loew, The George Washington Univ. (USA) . . . . . .[10331-1]

9:20: **Nonintrusive tools to detect salts contamination in masonry: the case study of Fontaine-Chaalis church**, David Giovannacci, Didier Brissaud, Jean-Didier Mertz, Lab. de Recherche des Monuments Historiques (France); Kamel Mouhoubi, Jean-Luc Bodnar, Univ. de Reims Champagne-Ardenne (France) . . . . . .[10331-2]

9:40: **Methodology proposal and case studies for diagnostics in cultural heritage by integration of terahertz, HMI, fluorescence, Raman, FT-IR and X-ray, noninvasive analysis**, Marcello Melis M.D., Giulia Rizza, Tiziana Pasciuto M.D., Profilocolore Srl (Italy); Ulderico Santamaria Sr., Univ. degli Studi della Tuscia (Italy) and Musei Vaticani (Italy); Fabio Morresi M.D., Musei Vaticani (Italy); Junliang Dong M.D., Alexandre Loquet M.D., David S. Citrin M.D., Unité Mixte Internationale 2958 Georgia Tech-CNRS (France). .[10331-4]

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

OPTICAL METROLOGY/DIGITAL OPTICAL TECHNOLOGIES 2017 PLENARY SESSION

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

Metasurface Diffractive Optics

Federico Capasso, Harvard Univ. (USA)

For details, please see page 3 or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

POSTERS—WEDNESDAY

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

Conference attendees are invited to attend the Optical Metrology Poster Session 2 on Wednesday. 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 11:30 through 12:30 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

The hybrid thermography approach applied to architectural structures, Stefano Sfarra, Dario Ambrosini, Domenica Paoletti, Iole Nardi, Giovanni Pasqualoni, Univ. degli Studi dell'Aquila (Italy) . . . . . .[10331-30]

Study of cement setting by dynamic speckle pattern and digital holographic interferometry, Fabio M. Vincitorio, Leandro J. Bertoluzzi, Emanuel I. Gomez Arn, Flurina L. L. Suri, Julio C. Gervasoni, Carlos E. Freyre, Dianela Gonzalez, Anabella Guilarducci, Nestor Ulibarrie, Univ. Tecnológica Nacional (Argentina) . . . . . .[10331-31]

Power Estimation of Martial Arts Movement with Different Physical, Mood and Behavior Using Motion Capture Camera, Mohamad Zubir Mat Jafri, Nurzaidi Azraai, Ahmad Afiq Sabqi Awang Soh, Univ. Sains Malaysia (Malaysia). . . . . .[10331-32]

RTI studies of conservation works on palaeolithic art at Kapova Cave (Russia), Alexander S. Pakhunov, Institute of Archaeology, Russian Academy of Sciences (Russian Federation) . . . . . .[10331-33]

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

SESSION 2

LOCATION: 12B . . . . . WED 13:40 TO 15:30

New Methods and Applications for Restoration

Session Chair: **Vincent Detalle,** Centre de Recherche et de Restauration des Musées de France (C2RMF) (France)

13:40: **Bridging research with innovative products: a compact hyperspectral camera for investigating artworks. A feasibility study** *(Invited Paper)*, Costanza Cucci, Andrea Casini, Lorenzo Stefani, Marcello Picollo, Istituto di Fisica Applicata "Nello Carrara" (Italy); Jouni Jussila, Specim Spectral Imaging Ltd. (Finland) . . . . . .[10331-5]

14:10: **Dating of bricks by optically stimulated luminescence (OSL) with modified protocol sheds new light on the chronology of medieval church**, Krzysztof Przegiętka, Alicja Chruścińska, Nicolaus Copernicus Univ. (Poland), LumiDatis Sp. z o.o. (Poland); Anna Cicha, Natalia Kijek, Nicolaus Copernicus Univ. (Poland); Piotr Palczewski, LumiDatis Sp. z o.o. (Poland), Nicolaus Copernicus Univ. (Poland); Krystyna Sulkowska-Tuszyńska, Nicolaus Copernicus Univ. (Poland). . . . . .[10331-6]

14:30: **Quantitative assessment in thermal image segmentation for artistic objects**, Bardia Yousefi, Univ. Laval (Canada); Stefano Sfarra, Univ. degli Studi dell'Aquila (Italy); Xavier P. V. Maldague, Univ. Laval (Canada) . . . . .[10331-7]

14:50: **Nondestructive evaluation of protective coatings for the conservation of industrial monuments**, Hubert Welp, Technische Fachhochschule Georg Agricola zu Bochum (Germany); Marcel Lenz, Ruhr-Univ. Bochum (Germany); Cristian Mazzon, Deutsches Bergbau-Museum Bochum (Germany); Christopher Dillmann, Technische Fachhochschule Georg Agricola zu Bochum (Germany); Michael Prange, Deutsches Bergbau-Museum Bochum (Germany); Nils C. Gerhardt, Martin R. Hofmann, Ruhr-Univ. Bochum (Germany) . . . . . .[10331-8]

15:10: **A versatile optical profilometer based on conoscopic holography sensors for multiscale acquisition of specular and diffusive surfaces in artworks**, Nicola Gaburro, Giacomo Marchioro, Claudia Daffara, Univ. degli Studi di Verona (Italy) . . . . . .[10331-9]

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

SESSION 3

LOCATION: 12B . . . . . WED 16:00 TO 17:50

3D Imaging, Scanning, Topography, and Tomography

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

16:00: **Nonlinear optical microscopy reveals the degradation of historic parchments** *(Invited Paper)*, Gaël Latour, Univ. Paris-Sud 11 (France) and Ctr. National de la Recherche Scientifique (France); Laurianne Robinet, Muséum national d'Histoire naturelle (France) and Ctr. National de la Recherche Scientifique (France) and Ministère de la Culture et de la Communication (France); François Portier, Univ. Pierre et Marie Curie (France) and Ctr. National de la Recherche Scientifique (France) and Collège de France (France); Pierre Leclerc, Guillaume Ducourthial, Marc Fabert, Frédéric Louradour, XLIM Institut

de Recherche, Univ. de Limoges (France) and Ctr. National de la Recherche Scientifique (France); Jocelyne Deschaux, Communauté d'Agglomération de l'Albigeois (France); Alexandre Dazzi, Ariane Deniset-Besseau, Univ. Paris-Sud 11 (France) and Ctr. National de la Recherche Scientifique (France); Marie-Claire Schanne-Klein, Lab. d'Optique et Biosciences (France) and Ctr. National de la Recherche Scientifique (France) and INSERM (France) . . . . . .[10331-10]

16:30: **Mapping the opacity of paint layers in coloured grounds paintings using optical coherence tomography**, Ping Liu, Technische Univ. Delft (Netherlands); Moorea Hall-Aquitania, Univ. van Amsterdam (Netherlands); Erma Hermens, Rijksmuseum (Netherlands); Roger M. Groves, Technische Univ. Delft (Netherlands) . . . . . .[10331-11]

16:50: **High-resolution mobile optical 3D scanner with color mapping**, Christian Bräuer-Burchardt, 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); Roland Ramm, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . . .[10331-12]

17:10: **Quantitative assessment of parchment degradation by polarization-resolved second harmonic microscopy**, Margaux Schmeltz, Lab. d'Optique et Biosciences, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and Institut National de la Santé et de la Recherche Médicale (France); Laurianne Robinet, Muséum national d'Histoire naturelle (France) and Ctr. National de la Recherche Scientifique (France); Claire Teulon, Guillaume Ducourthial, Marie-Claire Schanne-Klein, Lab. d'Optique et Biosciences, Ecole Polytechnique (France) and Ctr. National de la Recherche Scientifique (France) and Institut National de la Santé et de la Recherche Médicale (France); Gaël Latour, Univ. Paris-Sud 11 (France) and Ctr. National de la Recherche Scientifique (France). . . . . .[10331-13]

17:30: **Spectral-domain optical coherence tomography technology for diagnoses and detection of Chinese mural and pottery**, Manli Hu, Northwest Univ. (China) . . . . . .[10331-14]

THURSDAY 29 JUNE

SESSION 4

LOCATION: 12B . . . . . .THU 8:30 TO 10:00

Structure and Material Analysis

Session Chair: **John K. Delaney,** National Gallery of Art (USA)

8:30: **Lock-in-shearography for the detection of transport-induced damages on artwork** *(Invited Paper)*, Dominic Buchta, Univ. Stuttgart (Germany); Carolin Heinemann, 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. of Stuttgart (Germany) . . . . . .[10331-15]

9:00: **Method for dating old handwritten manuscripts based on spectral photometry of ink in near infrared range**, Igor P. Gurov, Mikhail V. Volkov, ITMO Univ. (Russian Federation); Konstantin Barsht, Svetlana Berezkina, Institute of Russian Literature (the Pushkin House) (Russian Federation) . . . . . .[10331-16]

9:20: **Deciphering innovative metallurgical processes though the study of the oldest lost-wax cast object using dynamics-photoluminescence imaging**, Mathieu Thoury, Tatiana Séverin-Fabiani, IPANEMA, Ctr. National de la Recherche Scientifique (France); Benoît Mille, Préhistoire et Technologie, Ctr. National de la Recherche Scientifique (France); Luc Robbiola, Travaux et Recherches Archéologiques sur les Cultures, les Espaces et les Sociétés (France); Matthieu Refregiers, Loïc Bertrand, Synchrotron SOLEIL (France) . . . . . .[10331-17]

9:40: **LIBS, Raman spectroscopy and optical microscopy analyses of superficial encrustations on ancient tesserae in Lebanon**, Anna Tomkowska, Krzysztof Chmielewski, Academy of Fine Arts, Warsaw (Poland); Roman Ostrowski, Wojciech Skrzyczanowski, Marek Strzelec, Military Univ. of Technology (Poland) . . . . . .[10331-18]

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

SESSION 5

LOCATION: 12B . . . . . THU 10:30 TO 11:40

Stratigraphic and Depth-resolved Methods

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

10:30: **3D internal reconstruction by the use of terahertz time domain imaging (THz-TDI) on stucco reliefs from 15th century** *(Invited Paper)*, Cheung Hoi Ching, Lab. de Recherche des Monuments Historiques (France); Gianluca Gariani, Ctr. de Recherche et de Restauration des Musées de France (France); David Giovannacci, Brissaud Didier, Lab. de Recherche des Monuments Historiques (France); Fabrice Goubard, Univ. de Cergy-Pontoise (France); Anne Bouquillon, Ctr. de Recherche et de Restauration des Musées de France (France); Marc Bormand, Musée du Louvre (France); Lise Leroux, Lab. de Recherche des Monuments Historiques (France) . . . . . .[10331-19]

11:00: **Surface and subsurface layers characterization in artworks using conoscopic laser holography and acoustic microscopy**, Giacomo Marchioro, Univ. degli Studi di Verona (Italy); Georgios K. Apostolidis, Georgios T. Karagiannis, The Ormylia Foundation (Greece); Monica Galeotti, Opificio delle Pietre Dure (Italy); Claudia Daffara, Univ. degli Studi di Verona (Italy) . . . . . .[10331-20]

11:20: **In-depth analyses of paleolithic pigments in cave climatic conditions**, Stephanie Touron, Barbara Trichereau, Delphine Syvilay, Lab. de Recherche des Monuments Historiques (France) . . . . . .[10331-21]

SESSION 6

LOCATION: 12B . . . . . .THU 11:40 TO 12:20

Methods and Instruments for the Upcoming European Research Infrastructure for Heritage Science I

Session Chair: **Luca Pezzati,** Istituto Nazionale di Ottica (Italy)

11:40: **LIBS-LIF-Raman, a new tool for the future E-RIHS**, Vincent Detalle, Ctr. de Recherche et de Restauration des Musées de France (France) . . . . . .[10331-22]

12:00: **Nonlinear optical microscopy imaging for nondestructive analysis of paintings**, Marta Castillejo, Instituto de Química Física Rocasolano, Consejo Superior de Investigaciones Científicas (Spain); Alice Dal Fovo, Jana Striova, Marco Barucci, Raffaella E. M. Fontana, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Chiara Grazia, Aldo Romani, Univ. degli Studi di Perugia (Italy); Sotiris Psilodimitrakopoulos, Demetrios Anglos, Georges Filippidis, Foundation for Research and Technology-Hellas (Greece); Magdalena A. Iwanicka, Piotr Targowski, Nicolaus Copernicus Univ. (Poland); Georgios T. Karagiannis, The Ormylia Foundation (Greece); Mohamed Oujja, Esther Carrasco, Mikel Sanz, Instituto de Química Física Rocasolano, Consejo Superior de Investigaciones Científicas (Spain) . . . . . .[10331-23]

Lunch Break . . . . . Thu 12:20 to 13:30

SESSION 7

LOCATION: 12B . . . . . THU 13:30 TO 15:30

Methods and Instruments for the Upcoming European Research Infrastructure for Heritage Science II

Session Chair: **Luca Pezzati,** Istituto Nazionale di Ottica (Italy)

13:30: **Analytical robustness of quantitative NIR chemical imaging for Islamic paper characterization**, Hend Mahgoub, Univ. College London (United Kingdom); John R. Gilchrist, Gilden Photonics Ltd. (United Kingdom); Thomas Fearn, Matija Strlic, Univ. College London (United Kingdom)[10331-24]

13:50: **Remote hyperspectral imaging with simultaneous 3D texture mapping**, Alex Hogg, Stuart Clark, Chi Shing Cheung, Haida Liang, Nottingham Trent Univ. (United Kingdom) . . . . . .[10331-25]

14:10: **Interferometry and thermography for cultural heritage structural diagnostic**, Vivi Tornari, Foundation for Research and Technology-Hellas (Greece) . . . . . .[10331-26]

14:30: **Contribution of computed tomography to the investigation of early La Tene culture iron artefacts**, Michal Vopalensky, Institute of Theoretical and Applied Mechanics (Czech Republic); Pavel Sankot, Martin Fort, National Museum (Czech Republic); Ivana Kumpova, Daniel Vavrik, Institute of Theoretical and Applied Mechanics (Czech Republic) . . . . . .[10331-27]

14:50: **Micro-XRF complemented by X-radiography and digital microscopy imaging for the study of hidden paintings**, Svetlana R. Gasanova, Nikolas Bakirtzis, Sorin Hermon, The Cyprus Institute (Cyprus) . . . . . .[10331-28]

15:10: **Combined use of optical coherence tomography and macro-XRF imaging for noninvasive evaluation of artworks**, Piotr Targowski, Magdalena A. Iwanicka, Marcin Sylwestrzak, Nicolaus Copernicus Univ. (Poland)[10331-29]

LOCATION: 12B . . . . . .15:30 TO 15:40

Closing Remarks

Luca Pezzati, Istituto Nazionale di Ottica-CNR (Italy); **Piotr Targowski,** Nicolaus Copernicus Univ. (Poland)

CONFERENCE 10332 · LOCATION: 12B

Monday - Tuesday 26–27 June 2017 • Proceedings of SPIE Vol. 10332

Videometrics, Range Imaging, and Applications

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,** AICON 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); **Stephen A. Kyle,** University College London (United Kingdom); **Derek D. Lichti,** Univ. of Calgary (Canada); **Thomas Luhmann,** Jade Hochschule (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); **Isabella Toschi,** Fondazione Bruno Kessler (Italy); **Patrick Westfeld,** TU Dresden (Germany); **Michael Yang,** Univ. Twente (Netherlands)

MONDAY 26 JUNE

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

LOCATION: SAAL 1, ICM . . . . . MON 10:00 TO 11:00

Putting a Spin on Photons

Jörg Wachtrup, Univ. of Stuttgart (Germany)

For details, please see page 3, or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

LOCATION: 12B . . . . . 11:25 TO 11:35

Opening Remarks

SESSION 1

LOCATION: 12B . . . . . MON 11:35 TO 13:00

Accuracy of Systems

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

11:35: **Development of a high accuracy multisensor, multitarget coordinate metrology system using frequency scanning interferometry** *(Invited Paper)*, Ben Hughes, Michael Campbell, Andrew Lewis, Mattia Lazzarini, Mattia Lazzerini, Nick Kay, Nick Kay, National Physical Lab. (United Kingdom) . . . . . .[10332-1]

12:10: **Rigorous accuracy assessment for 3D reconstruction using time-series dual fluoroscopy (DF) image pairs**, Kaleel Aldurgham, Derek D. Lichti, Gregor Kuntze, Janet Ronsky, Univ. of Calgary (Canada) . . . . . .[10332-3]

12:35: **Accurate characterisation of hole geometries by fringe projection profilometry**, Yuxiang Wu, Univ. of Electronic Science and Technology of China (China); Harshana G. Dantanarayana, Loughborough Univ. (United Kingdom); Huimin Yue, Univ. of Electronic Science and Technology of China (China); Jonathan M. Huntley, Loughborough Univ. (United Kingdom) [10332-4]

Lunch Break . . . . . .Mon 13:00 to 14:10

SESSION 2

LOCATION: 12B . . . . . MON 14:10 TO 15:50

Calibration and Matching

Session Chair: **Gabriele Guidi,** Politecnico di Milano (Italy)

14:10: **Optical aberrations in underwater photogrammetry with flat and hemispherical dome ports**, Fabio Menna, Erica Nocerino, Fabio Remondino, Fondazione Bruno Kessler (Italy) . . . . . .[10332-5]

14:30: **Determining the beam directions for the laser illumination calibration**, Victoria A. Sablina, Anatoly I. Novikov, Michael B. Nikiforov, Ryazan State Radio Engineering Univ. (Russian Federation) . . . . . .[10332-6]

14:50: **Out of lab calibration of a rotating 2D scanner for 3D mapping**, Rainer Koch, Technische Hochschule Nürnberg (Germany); Stefan May, Lena Böttcher, Maximilian Jahrsdörfer, Johannes Maier, Malte Trommer, Technische Hochschule Nürnberg Georg Simon Ohm (Germany); Andreas Nüchter, Julius-Maximilians-Univ. Würzburg (Germany) . . . . . .[10332-7]

15:10: **Compensating over-/underexposure in optical targets pose determination**, Marc Rufener, Emmanuel Cledat, Davide Antonio Cucci, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . .[10332-8]

15:30: **Appearance-based change detection in oblique-view image sequences from repeat-pass UAV missions**, Günter Saur, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . .[10332-9]

Coffee Break . . . . . .Mon 15:50 to 16:30

SESSION 3

LOCATION: 12B . . . . . MON 16:30 TO 17:50

3D Sensing

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

16:30: **A new angular and positioning sensor-system with vignetting field stop procedure allows 6 DoF per axis**, Engelbert Hofbauer, Technische Hochschule Deggendorf (Germany) . . . . . .[10332-10]

16:50: **Novel short-pulse laser diode source for high-resolution 3D flash LIDAR**, Celine Canal, Arnaud Laugustin, Andreas Kohl, Quantel Laser (France); Olivier Rabot, Quantel Laser Diodes (France) . . . . . .[10332-11]

17:10: **Methods for linear radial motion estimation in time-of-flight range imaging**, Lee Streeter, The Univ. of Waikato (New Zealand) . . . . . .[10332-12]

17:30: **Unsynchronized scanning with a low-cost laser range finder for real-time range imaging**, Isa Hatipoglu, Arie Nakhmani, The Univ. of Alabama at Birmingham (USA) . . . . . .[10332-13]

TUESDAY 27 JUNE

SESSION 4

LOCATION: 12B . . . . . TUE 8:30 TO 10:00

Optical Sensing

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

8:30: **Optical sensors for robotics and automotive applications: an industrial perspective** *(Invited Paper)*, Max Ruffo, Terabee (France) [10332-14]

9:00: **Comparison of calibration strategies for optical 3D scanners based on structured light projection using a new evaluation methodology**, Christian Bräuer-Burchardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Sandy Ölsner, Universitätsklinikum Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); 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) . . . . . .[10332-15]

9:20: **A photogrammetric technique for generation of an accurate multispectral optical flow dataset**, Vladimir V. Kniaz, GosNIIAS (Russian Federation) . . . . . .[10332-16]

9:40: **Localisation accuracy of semidense monocular SLAM**, Kristiaan Schreve, Pieter Du Plessies, Stellenbosch Univ. (South Africa); Matthias Raetsch, Reutlingen Univ. (Germany) . . . . . .[10332-17]

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

SESSION 5

LOCATION: 12B . . . . . TUE 10:30 TO 11:50

Mobile Sensing

Session Chair: **Gabriele Guidi,** Politecnico di Milano (Italy)

10:30: **Investigation of indoor and outdoor performance of two portable mobile mapping systems**, Erica Nocerino, Fabio Menna, Fabio Remondino, Isabella Toschi, Fondazione Bruno Kessler (Italy); Pablo Rodríguez-Gonzálvez, Univ. de Salamanca (Spain) . . . . . .[10332-18]

10:50: **A generic point error model for TLS derived point clouds**, Mustafa Ozendi, Bulent Ecevit Univ. (Turkey); Devrim Akca, Isik Üniv. (Turkey); Hüseyin Topan, Bulent Ecevit Univ. (Turkey) . . . . . .[10332-26]

11:10: **Precision analysis of triangulations using forward-facing vehicle-mounted cameras for augmented reality applications**, Stephan Schmid, Daimler AG (Germany); Dieter Fritsch, Institute for Photogrammetry, Univ. Stuttgart (Germany) . . . . . .[10332-20]

11:30: **Real-time localization of mobile device by filtering method for sensor fusion**, Takashi Fuse, The Univ. of Tokyo (Japan); Keita Nagara, Univ. of Tokyo (Japan) . . . . . .[10332-21]

Lunch Break . . . . . Tue 11:50 to 13:00

POSTERS—TUESDAY

LOCATION: ICM FOYER . . . . . TUE 13:00 TO 14:10

Conference attendees are invited to attend the Optical Metrology Poster Session 1 on Tuesday. 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 13:00 through 14:10 hrs on Tuesday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Construction of a vehicle for recording basic data of roads, Marcus Wittig, Westsächsische Hochschule Zwickau (Germany) . . . . . .[10332-19]

Depth image super-resolution via semi self-taught learning framework, Furong Zhao, Zhiguo Cao, Yang Xiao, Xiaodi Zhang, Ke Xian, Ruibo Li, Huazhong Univ. of Science and Technology (China) . . . . . .[10332-27]

Reliable stereo camera calibration with a 3D pattern defined by a laser tracker, Mariya G. Serikova, Optical-Electronic Devices, LLC (Russian Federation) and ITMO Univ. (Russian Federation); Andrei G. Anisimov, Technische Univ. Delft (Netherlands) and ITMO Univ. (Russian Federation); Anton V. Pantyushin, Optical-Electronic Devices, LLC (Russian Federation) and ITMO Univ. (Russian Federation). . . . . .[10332-28]

A decomposition algorithm of airborne laser waveforms integrating with neighborhood waveform information, Yingdan Wu, Hubei Univ. of Technology (China); Yang Ming, CCCC Second Highway Consultants Co., Ltd. (China) . . . . . .[10332-29]

Work modeling of the scanning type laser radar in real-time, Yevgeniy Muratov, Dmitry Kolchaev, Michael B. Nikiforov, Victoria A. Sablina, Ryazan State Radio Engineering Univ. (Russian Federation). . . . . .[10332-30]

Image fusion and enhancement using triangulated irregular networks, Gabriel Scarmana, University of Southern Queensland (Australia) . . .[10332-32]

SESSION 6

LOCATION: 12B . . . . . TUE 14:10 TO 15:30

Applications

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

14:10: **Stereo vision for fully automatic volumetric flow measurement in urban drainage structures**, Ekaterina Sirazitdinova, Igor Pesic, Patrick Schwehn, Hyuk Song, Uniklinik RWTH Aachen (Germany); Matthias Satzger, SEBA Hydrometrie GmbH & Co. KG (Germany); Dorothea Weingärtner, RWTH Aachen Univ. (Germany); Marcus Sattler, SEBA Hydrometrie GmbH & Co. KG (Germany); Thomas M. Deserno, Uniklinik RWTH Aachen (Germany) [10332-22]

14:30: **Detecting imperceptible movements in structures by means of video magnification**, Celestino Ordóñez, Carlos Cabo, Agustín Menéndez-Diaz, Silverio García-Cortés, Univ. de Oviedo (Spain) . . . . . .[10332-31]

14:50: **Lidar-based individual tree species classification using convolutional neural network**, Tomohiro Mizoguchi, Nihon Univ. (Japan); Akira Ishii, Hiroyuki Nakamura, Woodinfo Inc. (Japan); Tsuyoshi Inoue, Hisashi Takamatsu, Maruyoshi Inc. (Japan). . . . . .[10332-24]

15:10: **Accuracy evaluation of Structure from Motion surface 3D reconstruction**, Vladimir A. Knyaz, Sergey Zheltov, GosNIIAS (Russian Federation) . . . . . .[10332-25]

CONFERENCE 10333 · LOCATION: A21/22

Monday - Wednesday 26–28 June 2017 • Proceedings of SPIE Vol. 10333

Optical Methods for Inspection, Characterization, and Imaging of Biomaterials

Conference Chairs: **Pietro Ferraro,** Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Simonetta Grilli,** Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Monika Ritsch-Marte,** Medizinische Univ. Innsbruck (Austria); **Christoph K. Hitzenberger,** Medizinische Univ. Wien (Austria)

Programme Committee: **Luigi Ambrosio,** CNR (Italy); **Giuseppe Chirico,** Univ. degli Studi di Milano-Bicocca (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,** Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Serge Monneret,** Institut Fresnel (France); **Paolo A. Netti,** Univ. degli Studi di Napoli Federico II (Italy); **Fiorenzo Gabriele Omenetto,** Tufts Univ. (USA); **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,** Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Ruikang K. Wang,** Univ. of Washington (USA); **Zeev Zalevsky,** Bar-Ilan Univ. (Israel)

MONDAY 26 JUNE

LOCATION: A21/22 . . . . . 8:25 TO 8:30

Opening Remarks

SESSION 1

LOCATION: A21/22 . . . . . MON 8:30 TO 10:00

Optical Imaging

Session Chair: **Pietro Ferraro,** Istituto di Scienze applicata e Sistemi Intelligenti (Italy)

8:30: **Investigation on microfluidic particles manipulation by holographic 3D tracking strategies**, Teresa Cacace, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) and Univ. of Campania "L. Vanvitelli" (Italy); Melania paturzo, Pasquale Memmolo, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Massimo Vassalli, Consiglio Nazionale delle Ricerche (Italy); Massimiliano Fraldi, Giuseppe Mensitieri, Univ. degli Studi di Napoli Federico II (Italy); Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . .[10333-1]

8:50: **Characterization of the mechanical behavior and pathophysiological state of abdominal aortic aneurysms based on 4D ultrasound strain imaging** *(Invited Paper)*, Andreas Wittek, Univ. Siegen (Germany) and Johann Wolfgang Goethe-Univ. Frankfurt am Main (Germany); Christopher Blase, Wojciech Derwich M.D., Thomas Schmitz-Rixen M.D., Johann Wolfgang Goethe-Univ. Frankfurt am Main (Germany); Claus-Peter Fritzen, Univ. Siegen (Germany) . . . . . .[10333-2]

9:20: **Optical control of functional nanocontainers for force sensing**, Neus Oliver, Robert Meissner, Cornelia Denz, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . .[10333-3]

9:40: **Inspection of arterial-induced skin vibration by Moiré fringe with two-dimensional continuous wavelet transform**, Chun-Hsiung Wang, Shih-Yung Chiu, National Taiwan Univ. (Taiwan); Shu-Sheng Lee, National Taiwan Ocean Univ. (Taiwan); Yu-Hsiang Hsu, Chih-Kung Lee, National Taiwan Univ. (Taiwan) . . . . . .[10333-4]

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

LOCATION: SAAL 1, ICM . . . . . MON 10:00 TO 11:00

Putting a Spin on Photons

Jörg Wachtrup, Univ. of Stuttgart (Germany)

For details, please see page 3, or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

SESSION 2

LOCATION: A21/22 . . . . . MON 11:20 TO 13:00

Digital Holography and Tomography

Session Chair: **Aydogan Ozcan,** Univ. of California, Los Angeles (USA)

11:20: **Imaging cell clusters and tissue using learning tomography** *(Keynote Presentation)*, Morteza H. Shoreh, Alexandre Goy, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Ulugbek S. Kamilov, Mitsubishi Electric Research Laboratories (MERL) (USA); Michael Unser, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . .[10333-5]

11:50: **Biophysical monitoring of cell cultures for quality assessment utilizing digital holographic microscopy**, Lena Kastl, Michael Isbach, Dieter Dirksen, Jürgen Schnekenburger, Björn Kemper, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . .[10333-6]

12:10: **Peripheral blood mononuclear cells analysis in microfluidic flow by coherent imaging tools**, David Dannhauser, Domenico Rossi, Istituto Italiano di Tecnologia (Italy); Pasquale Memmolo, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) and Consiglio Nazionale delle Ricerche (Italy); Filippo Causa, Univ. degli Studi di Napoli Federico II (Italy); Andrea Finizio, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) and Consiglio Nazionale delle Ricerche (Italy); Paolo Antonio Netti, Univ. degli Studi di Napoli Federico II (Italy) . . . . . .[10333-7]

12:30: **Skin melanoma characterization with optical nondestructive techniques** *(Invited Paper)*, Fernando Mendoza-Santoyo, Jorge M. Flores Moreno, Maria del Socorro Hernandez Montes, Manuel De la Torre Ibarra, Centro de Investigaciones en Óptica, A.C. (Mexico). . . . . .[10333-8]

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

SESSION 3

LOCATION: A21/22 . . . . . MON 14:00 TO 16:20

Adaptive Optics

Session Chair: **Giuseppe Chirico,** Univ. degli Studi di Milano-Bicocca (Italy)

14:00: **Adaptive optics and biomedical imaging: improved characterization of thick tissues** *(Invited Paper)*, Juan M. Bueno, Lab. de Óptica Univ. de Murcia (Spain) . . . . . .[10333-9]

14:30: **Adaptive optics in visual science**, Michael Pircher, Medizinische Univ. Wien (Austria) . . . . . .[10333-10]

14:50: **Hybrid computational and physical adaptive optics for fluorescence microscopy**, Paolo Pozzi, Dean Wilding, Technische Univ. Delft (Netherlands); Oleg Soloviev, Gleb Vdovin, Technische Univ. Delft (Netherlands) and Flexible Optical B.V. (Netherlands) and ITMO Univ. (Russian Federation); Michel Verhaegen, Technische Univ. Delft (Netherlands). . . . . .[10333-11]

15:10: **Digital wavefront sensing and aberration correction for in-vivo retinal imaging**, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria)[10333-12]

15:30: **Scanless nonlinear optical microscope for image reconstruction and space-time correlation analysis**, Maddalena Collini, Nicolo' G. Ceffa, Laura Sironi, Fabrizio Radaelli, Laura D'Alfonso, Univ. degli Studi di Milano-Bicocca (Italy); Paolo Pozzi, Technische Univ. Delft (Netherlands); Giuseppe Chirico, Univ. degli Studi di Milano-Bicocca (Italy) . . . . . .[10333-13]

15:50: **Adaptive optics for in-vivo exploration of human retinal structures** *(Invited Paper)*, Michel Paques, Ctr. Hospitalier National d'Opthalmologie des Quinze-Vingts (France); Serge C. Meimon, ONERA (France); Katharine Grieve, Institut Langevin (France); Florence Rossant, Ctr. Hospitalier National d'Opthalmologie des Quinze-Vingts (France) . . . . . .[10333-14]

Coffee Break . . . . . .Mon 16:20 to 16:50

SESSION 4

LOCATION: A21/22 . . . . . MON 16:50 TO 18:10

Interferometry

Session Chair: **Hui Cao,** Yale Univ. (USA)

16:50: **High-speed single-pixel digital holography**, Humberto González, Univ. Autónoma de Zacatecas (Mexico) and Univ. Jaume I (Spain); Lluís Martínez-León, Fernando Soldevila, Univ. Jaume I (Spain); Maria Araiza-Esquivel, Univ. Autónoma de Zacatecas (Mexico); Enrique Tajahuerce, Jesús Lancis, Univ. Jaume I (Spain) . . . . . .[10333-15]

17:10: **Real-time 3D optical sectioning by differential interference contrast microscope using pixelated polarization camera**, Yukitoshi Otani, Shuhei Shibata, Utsunomiya Univ. (Japan); Hiroshi Ishiwata, Olympus Corp. (Japan); Masaru Matsuda, Toyohiko Yatagai, Utsunomiya Univ. (Japan). . . . .[10333-16]

17:30: **Simultaneous shape and deformation measurements in a blood vessel model by two wavelength interferometry**, Nieves Andrés, Cristina Pinto, Julia Lobera, Virginia Palero, M. Pilar Arroyo, Univ. de Zaragoza (Spain) . . . . . .[10333-17]

17:50: **Multiplexed two in-line holographic recordings for flow characterization in a flexible vessel**, Julia Lobera, Virginia R. Palero, Ana M. López Torres, Nieves Andrés, M. Pilar Arroyo, Eva M. Roche, Marina Gómez Clemente, Univ. de Zaragoza (Spain) . . . . . .[10333-18]

TUESDAY 27 JUNE

SESSION 5

LOCATION: A21/22 . . . . . TUE 8:20 TO 10:10

Optical Microscopy I

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

8:20: **Increasing the space-time product of super-resolution structured illumination microscopy by means of 2-pattern illumination**, Fedor M. Inochkin, ITMO Univ. (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation); Paolo Pozzi, Technische Univ. Delft (Netherlands); Vitalii V. Bezzubik, Nickolay R. Belashenkov, ITMO Univ. (Russian Federation) . . . . . .[10333-19]

8:40: **In-focal-plane characterization of excitation distribution for quantitative fluorescence microscopy applications**, Klaus Dietrich, Martina Brülisauer, Emine Cagin, Dietmar Bertsch, Stefan Lüthi, Peter Heeb, NTB Interstaatliche Hochschule für Technik Buchs (Switzerland); Ulrich Stärker, Volpi AG (Switzerland); André Bernard, NTB Interstaatliche Hochschule für Technik Buchs (Switzerland) . . . . . .[10333-20]

9:00: **Easy and versatile adaptive optics setup with deformable lens for high-resolution microscopy**, Paolo Pozzi, Technische Univ. Delft (Netherlands); Martino Quintavalla, CNR-IFN Padova (Italy); Hans Verstraete, Hielke Bijlsma, Technische Univ. Delft (Netherlands); Stefano Bonora, CNR-IFN Padova (Italy); Michel Verhaegen, Technische Univ. Delft (Netherlands) . . . . . .[10333-21]

9:20: **An all-holographic interferometer for phase contrast imaging**, Philipp Zelger, Alexander Jesacher, Stefan Bernet, Monika Ritsch-Marte, Medizinische Univ. Innsbruck (Austria) . . . . . .[10333-22]

9:40: **Label-free imaging of single microtubule dynamics using spatial light interference microscopy** *(Keynote Presentation)*, Mikhail E. Kandel, Univ. of Illinois at Urbana-Champaign (USA); Kai Wen Teng, Univ. of Illinois (USA); Paul R. Selvin, Gabriel Popescu, Univ. of Illinois at Urbana-Champaign (USA) . . . . . .[10333-23]

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

SESSION 6

LOCATION: A21/22 . . . . . TUE 10:30 TO 12:50

Optical Microscopy II

Session Chair: **Pasquale Memmolo,** Istituto di Scienze applicata e Sistemi Intelligenti (Italy)

10:30: **Digital holographic microscopy as a technique to monitor macrophages infected by leishmania**, Freddy A. Monroy Ramírez, Estefania Mendoza Rodriguez, Caori A. Organista Castelblanco, Marcela Camacho, Univ. Nacional de Colombia (Colombia). . . . . .[10333-24]

10:50: **On-axis programmable microscope using liquid crystal spatial light modulator**, Pascuala García-Martínez, Univ. de València (Spain); José Luis Martínez, Ignacio Moreno, Univ. Miguel Hernández de Elche (Spain) [10333-25]

11:10: **A pocket device for high-throughput optofluidic holographic microscopy**, Vittorio Bianco, Biagio Mandracchia, Melania Paturzo, Valentina Marchesano, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Alessia Bramanti, Giovanni Pioggia, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) and IRCCS (Italy); Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy). . . . . .[10333-26]

11:30: **Label-free investigation of the effects of lithium niobate polarization on cell adhesion**, Biagio Mandracchia, Oriella Gennari, Melania Paturzo, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Simonetta Grilli, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10333-27]

11:50: **Multimodal nanoscale microscopy** *(Invited Paper)*, Alberto Diaspro, Istituto Italiano di Tecnologia (Italy) and Univ. of Genoa (Italy) . . . . . .[10333-28]

12:20: **Applications of holographic on-chip microscopy** *(Keynote Presentation)*, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . .[10333-29]

Lunch Break . . . . . Tue 12:50 to 14:10

SESSION 7

LOCATION: A21/22 . . . . . TUE 14:10 TO 15:30

Interference and Speckle

Session Chair: **Zeev Zalevsky,** Bar-Ilan Univ. (Israel)

14:10: **Stereo microscope 3D digital image correlation system for micromechanical characterization of biomaterials**, Tomasz Rusin, Dantec Dynamics GmbH (Germany); Magdalena Kopernik, AGH Univ. of Science and Technology (Poland); Kamil Joszko, Silesian Univ. of Technology (Poland) . . . . . .[10333-30]

14:30: **Correlation plenoptic imaging** *(Invited Paper)*, Milena D'Angelo, Francesco Di Lena, Augusto Garuccio, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare Sezione di Bari (Italy); Aldo Mazzilli, Univ. degli Studi di Bari Aldo Moro (Italy); Francesco V. Pepe, Museo Storico della Fisica e Ctr. Studi e Ricerche "Enrico Fermi" (Italy) and Istituto Nazionale di Fisica Nucleare Sezione di Bari (Italy); Giuliano Scarcelli, Univ. of Maryland, College Park (USA) . . . . . .[10333-32]

15:00: **Spatial coherence engineering of lasers for speckle-free and multimodality imaging** *(Invited Paper)*, Hui Cao, Yale University (USA) . . . . . .[10333-33]

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

SESSION 8

LOCATION: A21/22 . . . . . TUE 16:00 TO 17:30

Optical Coherence Tomography

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

16:00: **Optical metrology of the eye and of ocular tissues** *(Keynote Presentation)*, Christoph K. Hitzenberger, Medizinische Univ. Wien (Austria) . . . . . .[10333-35]

16:30: **Tomographic flow cytometry assisted by intelligent wavefronts analysis**, Francesco Merola, Pasquale Memmolo, Lisa Miccio, Martina Mugnano, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10333-36]

16:50: **3D registration of depth data of porous surface coatings based on 3D phase correlation and the Trimmed ICP algorithm**, Nina Loftfield, Markus Kästner, Eduard Reithmeier, Institut für Mess- und Regelungstechnik, Leibniz Univ. Hannover (Germany) . . . . . .[10333-37]

17:10: **Red blood cells as microlenses: wavefront analysis and applications**, Francesco Merola, Pasquale Memmolo, Lisa Miccio, Martina Mugnano, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10333-38]

WEDNESDAY 28 JUNE

SESSION 9

LOCATION: A21/22 . . . . . WED 8:30 TO 10:00

Sensing and Detection

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

8:30: **Algorithm for multiframe full-field heterodyne digital holographic microscopy**, Xiaoyu Lv, Wenxi Zhang, Zhou Wu, Yang Li, Xinxin Kong, Academy of Opto-Electronics, CAS (China) . . . . . .[10333-39]

8:50: **Adaptive lens aberrations correction in in-vivo optical coherence tomography**, Martino Quintavalla, CNR-IFN Padova (Italy); Jacopo Mocci, Univ. degli Studi di Verona (Italy); Michelle Cua, Sujin Lee, Yifan Jian, Simon Fraser Univ. (Canada); Paolo Pozzi, Technische Univ. Delft (Netherlands); Cosmo Trestino, CNR-IFN Padova (Italy); Hans Verstraete, Technische Univ. Delft (Netherlands); Daniel J. Wahl, Simon Fraser Univ. (Canada); Riccardo Muradore, Univ. degli Studi di Verona (Italy); Robert J. Zawadzki, Univ. of California, Davis (USA); Michel Verhaegen, Technische Univ. Delft (Netherlands); Marinko V. Sarunic, Simon Fraser Univ. (Canada); Stefano Bonora, CNR-IFN Padova (Italy) . . . . . .[10333-40]

9:10: **Simultaneous real-time application and direct comparison of optical resonance sensing and fluorescence tagging techniques for biochemical component detection**, Anton V. Saetchnikov, Ruhr-Univ. Bochum (Germany) and Belarusian State Univ. (Belarus); Elina A. Tcherniavskaia, Vladimir A. Saetchnikov, Belarusian State Univ. (Belarus); Andreas Ostendorf, Ruhr-Univ. Bochum (Germany) . . . . . .[10333-41]

9:30: **Hybrid nanoparticles for therapy and diagnosis: au nanoprisms for gastrointestinal cancer** *(Keynote Presentation)*, Jesus M de la Fuente, Instituto de Ciencia de Materiales de Aragon, CSIC (Spain). . . . . .[10333-42]

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

OPTICAL METROLOGY/DIGITAL OPTICAL TECHNOLOGIES 2017 PLENARY SESSION

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

Metasurface Diffractive Optics

Federico Capasso, Harvard Univ. (USA)

For details, please see page 3 or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

POSTERS—WEDNESDAY

LOCATION: ICM FOYER . . . . . .WED 12:40 TO 13:50

Conference attendees are invited to attend the Optical Metrology Poster Session 2 on Wednesday. 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 12:40 through 13:50 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Design of the algorithm of photons migration in the multilayer skin structure, Anastasiia Bulykina, Victoria A. Ryzhova, Valery V. Korotaev, Nikita Samokhin, ITMO Univ. (Russian Federation). . . . . .[10333-49]

Polarization visualization of changes of anisotropic meat structure, Anastasia A. Blokhina, Anastasiya Y. Lobanova, Victoria A. Ryzhova, ITMO Univ. (Russian Federation); Maksim A. Kleshchenok, ITMO Univ. (Russian Federation) and Geomash engineering Ltd (Russian Federation) . . . .[10333-51]

The original method for imaging of biological tissues in optical coherence tomography with usage of hyperchromatic lens, Dmitrii I. Egorov, ITMO Univ. (Russian Federation). . . . . .[10333-53]

The box fractal dimension in speckle images, Héctor J. Rabal, Ctr. de Investigaciones Ópticas, Univ. Nacional de la Plata (Argentina); Eduardo Grumel, Nelly Cap, Leandro Buffarini, Marcelo Trivi, Ctr. de Investigaciones Ópticas (Argentina) . . . . . .[10333-54]

Refractive index effect on aberration correction of optical tweezers, Samane Birzhandi, Univ. of Zanjan (Iran, Islamic Republic of); Khosro Madanipour, Shahrzad Shahrabi, Amirkabir Univ. of Technology (Iran, Islamic Republic of); Seed Ghanbari, Univ. of Zanjan (Iran, Islamic Republic of) . . . . . .[10333-57]

Real-time quantitative phase microscopy with single-shot transport of intensity equation, Liang Xue, Shanghai Univ. of Electric Power (China); Wei Yu, Xiaolin Tian, Xiaoliang He, Cheng Liu, Shouyu Wang, Jiangnan Univ. (China) . . . . . .[10333-58]

Line-field swept source optical coherence tomography system for evaluating microstructure of objects in near-infrared spectral range, Igor P. Gurov, Nikita Margaryants, Aleksei Pimenov, ITMO Univ. (Russian Federation) . . . . . .[10333-60]

Programmable phase contrast microscopy with spatial light modulators, Armin Hofmeister, Gregor Thalhammer, Monika Ritsch-Marte, Alexander Jesacher, Medizinische Univ. Innsbruck (Austria). . . . . .[10333-61]

Food quality inspection by speckle decorrelation properties of bacteria colonies, Vittorio Bianco, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Biagio Mandracchia, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) and Univ. degli Studi di Napoli Federico II (Italy); Filomena Nazzaro, Istituto di Scienze dell'Alimentazione (Italy); Valentina Marchesano, Oriella Gennari, Melania Paturzo, Simonetta Grilli, Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy) . . . . . .[10333-62]

Interferometric measurement of film thickness during bubble blowing, Zhe Wang, Beijing Univ. of Technology (China); Biagio Mandracchia, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Vincenzo Ferraro, Daniele Tammaro, Univ. degli Studi di Napoli Federico II (Italy); Pietro Ferraro, Istituto di Scienze applicata e Sistemi Intelligenti (Italy); Ernesto Di Maio, Pier Luca Maffettone, Univ. degli Studi di Napoli Federico II (Italy) . . . . . .[10333-63]

Label-free imaging and analysis of small lipid droplets in adipocyte cells by stimulated Raman microscopy, Annalisa D'Arco, Maria Antonietta Ferrara, Institute for Microelectronics and Microsystems (Italy); Angela Filograna, Institut de Biochimie et Génétique Cellulaires (Italy); Maurizio Indolfi, Vitaliano Tufano, Consiglio Nazionale delle Ricerche (Italy); Carmen Valente, Institute of Protein Biochemistry (CNR) (Italy); Luigi Zeni, University of Campania Luigi Vanvitelli (Italy); Luigi Sirleto, Institute for Microelectronics and Microsystems (Italy) . . . . . .[10333-64]

SESSION 10

LOCATION: A21/22 . . . . . .WED 13:50 TO 15:30

Optical Methods

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

13:50: **Bio-derived and biodegradable microlasers and optical waveguides for biosensors, cell tracking and photomedicine** *(Invited Paper)*, Matjaž Humar, Jožef Stefan Institute (Slovenia) . . . . . .[10333-43]

14:20: **Implementation of stimulated Raman losses and stimulated Raman gain microscopy using three femtosecond laser sources**, Annalisa D'Arco, Maria Anotonietta Ferrara, Maurizio Indolfi, Vitaliano Tufano, Luigi Sirleto, Institute for Microelectronics and Microsystems (Italy). . . . . .[10333-44]

14:40: **Using Shack-Hartmann wavefront sensors and Zernike coefficients for beam characterisation: numerical procedures**, Salvador Bosch Puig, Santiago Vallmitjana, Antonio Marzoa, Univ. de Barcelona (Spain); Justo Arines, Eva Acosta, Univ. de Santiago de Compostela (Spain) . . . . . .[10333-45]

15:00: **Systemic imaging with light sheet microscopy** *(Invited Paper)*, Alessia Candeo, Petra Paiè, Politecnico di Milano (Italy); Francesca Bragheri, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Gianluca Valentini, Politecnico di Milano (Italy); Roberto Osellame, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Andrea Bassi, Politecnico di Milano (Italy) . . . . . .[10333-46]

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

SESSION 11

LOCATION: A21/22 . . . . . WED 16:00 TO 17:20

Spectroscopy and Scattering

Session Chair: **Monika Ritsch-Marte,** Medizinische Univ. Innsbruck (Austria)

16:00: **Micro-Raman analysis of glisterings in intraocular lenses**, Giulia Rusciano, Giuseppe Pesce, Gianluigi Zito, Antonio Sasso, Anna Martinez, Univ. degli Studi di Napoli Federico II (Italy). . . . . .[10333-47]

16:20: **Using engineered point spread functions in image scanning microscopy**, Clemens Roider, Medizinische Univ. Innsbruck (Austria); Rafael Piestun, Univ. of Colorado Boulder (USA); Monika Ritsch-Marte, Alexander Jesacher, Medizinische Univ. Innsbruck (Austria). . . . . .[10333-48]

16:40: **Technological aspects of manufacturing terahertz photonic crystal waveguides based on sapphire shaped crystals**, Gleb M. Katyba, Institute of Solid State Physics Russian Academy of Sciences (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation); Kirill I. Zaytsev, Bauman Moscow State Technical Univ. (Russian Federation) and Institute of Improvement of Professional Skill of the Federal Medico-Biological Agency of Russia (Russian Federation) and I.M. Sechenov First Moscow State Medical Univ. (Russian Federation); Sergey N Rossolenko, Institute of Solid State Physics Russian Academy of Sciences (Russian Federation); Irina A. Shikunova, Institute of Solid State Physics RAS (Russian Federation) and Institute of Improvement of Professional Skill of the Federal Medico-Biological Agency of Russia (Russian Federation); Sergey L Shikunov, Dmitriy O Stryukov, Institute of Solid State Physics Russian Academy of Sciences (Russian Federation); Stanislav O. Yurchenko, Bauman Moscow State Technical Univ. (Russian Federation); Vladimir N. Kurlov, Institute of Solid State Physics RAS (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation) . . . . . .[10333-50]

17:00: **Method and device based on human skin autofluorescence investigation for characterization of patients with coronary artery disease**, Dmitriy V. Kornilin, Vladimir N. Grishanov, Samara Univ. (Russian Federation) . . . . . .[10333-52]

17:20: **Nonlinear absorption coefficient measurement of nanofluids using Moiré deflectometry technique**, Shahrzad Shahrabi Farahani, Khosro Madanipour, Amirkabir Univ. of Technology (Iran, Islamic Republic of) . . . . . .[10333-56]

CONFERENCE 10334 · LOCATION: 12A

Thursday 29–29 June 2017 • Proceedings of SPIE Vol. 10334

Automated Visual Inspection and Machine Vision

Conference Chairs: **Jürgen Beyerer,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany), Karlsruher Institut für Technologie (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,** Karlsruher Institut für Technologie (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,** Duale Hochschule Baden-Würtemberg (Germany); **Ernst Wiedenmann,** Serious Enterprises (Germany); **Volker Willert,** Technische Univ. Darmstadt (Germany)

THURSDAY 29 JUNE

LOCATION: 12A . . . . . 8:55 TO 9:00

Opening Remarks

SESSION 1

LOCATION: 12A . . . . . THU 9:00 TO 10:00

Image Acquisition

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

9:00: **Motion blur characterization and compensation for line scan (1D) cameras**, Jose Oramas M., KU Leuven (Belgium); Agusmian P Ompusunggu, Flanders Make (Belgium); Tinne Tuytelaars, KU Leuven (Belgium); Abdellatif Bey-Temsamani, Flanders Make (Belgium). . . . . .[10334-1]

9:20: **Structural influence of a spatial light modulator on generated wavefronts for speckle-based shape measurement**, Laura M. Aulbach, Technische Univ. München (Germany); Félix Salazar-Bloise, Univ. Politécnica de Madrid (Spain); Min Lu, Shengjia Wang, Alexander W. Koch, Technische Univ. München (Germany). . . . . .[10334-2]

9:40: **Robust and efficient modulation transfer function measurement with CMOS color sensors**, Raziyeh Amirian-Farsani, Justus-Liebig-Univ. Giessen (Germany); Thomas Sure, Technische Hochschule Mittelhessen (Germany); Uwe Apel, Robert Bosch GmbH (Germany) . . . . . .[10334-3]

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

SESSION 2

LOCATION: 12A . . . . . THU 10:30 TO 11:10

Simulation

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

10:30: **Simulated BRDF based on measured surface topography of metal**, Haiyue Yang, Univ. Stuttgart (Germany); Tobias Haist, Marc Gronle, Wolfgang Osten, Institut für Technische Optik (Germany) . . . . . .[10334-4]

10:50: **Image formation simulation for computer aided inspection planning of machine vision systems**, Stephan Irgenfried, Stephan Bergmann, Mahsa Mohammadikaji, Karlsruher Institut für Technologie (Germany); Jürgen Beyerer, Karlsruher Institut für Technologie (Germany) and Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Carsten Dachsbacher, Heinz Wörn, Karlsruher Institut für Technologie (Germany) . . . . . .[10334-5]

SESSION 3

LOCATION: 12A . . . . . THU 11:10 TO 11:50

Multispectral inspection

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

11:10: **Detection of cracks on concrete surfaces by hyperspectral images processing**, Bruno Santos, Jónatas Valença, Eduardo Júlio, Instituto Superior Técnico (Portugal) . . . . . .[10334-6]

11:30: **Optical determination of material abundances by using neural networks for the derivation of spectral filters**, Wolfgang Krippner, Karlsruher Institut für Technologie (Germany); Felix Wagner, Karlsruher Institut für Technologie (KIT) (Germany); Sebastian Bauer, Fernando Puente León, Karlsruher Institut für Technologie (Germany). . . . . .[10334-7]

Lunch Break . . . . . Thu 11:50 to 12:50

POSTERS—THURSDAY

LOCATION: ICM FOYER . . . . . THU 12:50 TO 13:50

Conference attendees are invited to attend the Optical Metrology Poster Session 3 on Thursday. 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 12:50 hrs through 13:50 hrs on Thursday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Study of landmarks estimation stability produced by AAM, Victor Glebov, Oleg U. Lashmanov, ITMO Univ. (Russian Federation). . . . . .[10334-13]

Stereo matching using the neighboring system constructed with MST, Ran Li, Zhiguo Cao, Huazhong Univ. of Science and Technology (China); Qian Zhang, Hubei Univ. (China); Yang Xiao, Ke Xian, Huazhong Univ. of Science and Technology (China). . . . . .[10334-14]

High-reflection microprismatic material as a base for passive reference marks in machine vision metrology applications, Anna V. Trushkina, Aleksandr S. Vasilev, ITMO Univ. (Russian Federation); Mariya G. Serikova, ITMO Univ. (Russian Federation) and Optical-Electronic Devices, LLC (Russian Federation); Andrei G. Anisimov, Technische Univ. Delft (Netherlands) . . . . . .[10334-15]

A novel sparse-to-dense depth map generation framework for monocular videos, Runze Zhang, Zhiguo Cao, Huazhong Univ. of Science and Technology (China); Qian Zhang, Hubei Univ. (China); Yang Xiao, Ruibo Li, Huazhong Univ. of Science and Technology (China). . . . . .[10334-16]

A novel airport extraction model based on saliency region detection for high spatial resolution remote sensing images, Wen Lv, Libao Zhang, Yongchun Zhu, Beijing Normal Univ. (China) . . . . . .[10334-17]

Real-time detection of abandoned bags using CNN , Sergey V. Sidyakin, Boris V. Vishnyakov, GosNIIAS (Russian Federation) . . . . . .[10334-18]

A novel vehicle tracking algorithm based on mean shift and active contour model in complex environment, Lei Cai, Lin Wang, Research Institute of Highway (China); Libao Zhang, Wen Lv, Beijing Normal Univ. (China)[10334-19]

Method of measuring linear displacements of objects based on Fresnel diffraction pattern position, Alexander Ivanov, Anvar Zakirov, Vyacheslav Porokhin, Ramil Minnigazimov, Ksenia Nizhegorodova, ITMO Univ. (Russian Federation) . . . . . .[10334-20]

A novel visual saliency analysis model based on dynamic multiple feature combination strategy, Jing Lv, North China Electric Power University (China); Qi Ye, Wen Lv, Beijing Normal Univ. (China); Libao Zhang, Beijing Normal University (China). . . . . .[10334-21]

The experimental evaluation of position control error in swarming visual sensor network for multiple object tracking, Yuri P. Baranov, Ural Optical and Mechanical Plant (Russian Federation) and ITMO Univ. (Russian Federation); Sergey N. Yarishev, ITMO Univ. (Russian Federation); Andrey Y. Rodionov, Alexey N. Chivanov, Ural Optical and Mechanical Plant (Russian Federation); Andrey V. Obrezkov, Ural Optical and Mechanical Plant (Russian Federation) and S.I. Vavilov State Optical Institute (Russian Federation) . . . . . .[10334-22]

Automatic 3D inspection metrology for high-temperature objects, Liya Han, Zhongwei Li, Kai Zhong, Yusheng Shi, Xu Cheng, Guomin Zhan, Ran Chen, Huazhong Univ. of Science and Technology (China) . . . . . .[10334-23]

CPU architecture for a fast and energy-saving calculation of convolution neural networks, Florian Knoll, Stephan H. Hussmann, Fachhochschule Westküste Heide (Germany) . . . . . .[10334-24]

Pedestrian detection in video surveillance using fully convolutional YOLO neural network, Vladimir V. Molchanov, Boris V. Vishnyakov, Yury V. Vizilter, GosNIIAS (Russian Federation); Oxana V. Vishnyakova, The Higher School of Economics (Russian Federation); Vladimir A. Knyaz, GosNIIAS (Russian Federation) . . . . . .[10334-25]

SESSION 4

LOCATION: 12A . . . . . THU 13:50 TO 15:30

Inspection, Monitoring and Detection

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

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SPIE. DIGITAL OPTICAL TECHNOLOGIES

SPIE DIGITAL OPTICAL TECHNOLOIGES

2017 Symposium Chairs

Bernard C. Kress,
Microsoft Corp.
(United States)

Wolfgang Osten,
Univ. Stuttgart
(Germany)

H. Paul Urbach,
Technische Univ. Delft
(Netherlands)

- Novel optics for Augmented, Mixed and Virtual Reality systems
- Computational optics
- Digital optics for image formation
- Switchable, tunable and digitally reconfigurable optics
- Digital optics for sensing and authentication
- Integrated digital photonics

Technical Committee

Partha P. Banerjee, Univ. of Dayton (USA)

Hans I. Bjelkhagen, Glyndwr Univ., Ctr. for Ultrarealistic Imaging (United Kingdom)

Arie den Boef, ASML Netherlands B.V. (Netherlands)

Federico Capasso, Harvard School of Engineering and Applied Sciences (USA)

Oliver Cossairt, Northwestern Univ. (USA)

Andreas Hermerschmidt, HOLOEYE Photonics AG (Germany)

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Byoungho Lee, Seoul National Univ. (Korea, Republic of)

Scott McEldowney, Oculus VR, LLC (USA)

Juan C. Minano, Univ. Politecnica de Madrid/ Ctr. for Virtual Reality CeDInt (Spain)

Wolfgang Osten, Univ. Stuttgart (Germany)

Olivier Parriaux, Lab. Hubert Curien (France)

Silvania F. Pereira, Technische Univ. Delft (Netherlands)

Christophe Peroz, Magic Leap, Inc. (USA)

Pascal Picart, Univ. du Maine (France)

Ting-Chung Poon, Virginia Polytechnic Institute and State Univ. (USA)

Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

Adrian Travis, Microsoft Corp. (France)

H. Paul Urbach, Technische Univ. Delft (Netherlands)

Reinhard Voelkel, SUSS MicroOptics SA (Switzerland)

CONFERENCE 10335 · LOCATION: LEOPOLD

Monday - Wednesday 26–28 June 2017 • Proceedings of SPIE Vol. 10335

Digital Optical Technologies

Conference Chairs: **Bernard C. Kress,** Microsoft Corp. (USA); **Wolfgang Osten,** Univ. Stuttgart (Germany); **H. Paul Urbach,** Technische Univ. Delft (Netherlands)

Programme Committee: **Partha P. Banerjee,** Univ. of Dayton (USA); **Hans I. Bjelkhagen,** Glyndwr Univ., Ctr. for Ultrarealistic Imaging (United Kingdom); **Arie den Boef,** ASML Netherlands B.V. (Netherlands); **Federico Capasso,** Harvard School of Engineering and Applied Sciences (USA); **Oliver Cossairt,** Northwestern Univ. (USA); **Andreas Hermerschmidt,** HOLOEYE Photonics AG (Germany); **Yoshio Hayasaki,** Utsunomiya Univ. (Japan); **Hans Peter Herzig,** Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Hong Hua,** College of Optical Sciences, The Univ. of Arizona (USA); **Fu-Chung Huang,** nVIDIA Corp. (USA); **Bahram Javidi,** Univ. of Connecticut (USA); **Sabina Jeschke,** RWTH Aachen Univ. (Germany); **Dirk Kanngiesser,** Seebright inc. (USA); **Norbert Kerwien,** Carl Zeiss AG (Germany); **Byoungho Lee,** Seoul National Univ. (Korea, Republic of); **Scott McEldowney,** Facebook/Oculus VR, LLC (USA); **Juan C. Minano,** Univ. Politecnica de Madrid/Ctr. for Virtual Reality CeDInt (Spain); **Olivier Parriaux,** Lab. Hubert Curien (France); **Silvania F. Pereira,** Technische Univ. Delft (Netherlands); **Christophe Peroz,** Magic Leap, Inc. (USA); **Pascal Picart,** Univ. du Maine (France); **Ting-Chung Poon,** Virginia Polytechnic Institute and State Univ. (USA); **Demetri Psaltis,** Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Adrian Travis,** Microsoft Research (France); **Reinhard Voelkel,** SUSS MicroOptics SA (Switzerland)

MONDAY 26 JUNE

LOCATION: LEOPOLD . . . . . 7:45 TO 8:00

Welcome and Introduction

SESSION 1

LOCATION: LEOPOLD . . . . . MON 8:00 TO 9:50

Optical Architectures for Augmented, Mixed and Virtual Reality HMDs

Session Chairs: **Juan C. Miñano,** Limbak (Spain); **Byoungho Lee,** Seoul National Univ. (Korea, Republic of)

8:00: **See-through 3D technology for augmented reality** *(Invited Paper)*, Byoungho Lee, Seungjae Lee, Gang Li, Changwon Jang, Jong-Young Hong, Seoul National Univ. (Korea, Republic of) . . . . . .[10335-1]

8:30: **OLED microdisplays in near-to-eye applications: challenges and solutions**, Uwe Vogel, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Bernd Richter, Philipp Wartenberg, Peter Koenig, Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany); Olaf R. Hild, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik FEP (Germany); Karsten Fehse, Matthias Schober, Elisabeth Bodenstein, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Beatrice Beyer, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik FEP (Germany). . . . . .[10335-2]

8:50: **Time multiplexing for increased FOV and resolution in virtual reality**, Juan C. Minano, Pablo Benítez, Univ. Politécnica de Madrid (Spain) and Limbak (Spain); Dejan Grabovickic, Pablo Zamora, Marina Buljan, Bharathwaj A. Narasimhan, Limbak (Spain) . . . . . .[10335-3]

9:10: **Phase space methods in HMD systems**, James Babington, Qioptiq Ltd. (United Kingdom). . . . . .[10335-4]

9:30: **Comparison of different designs of head mounted displays with large field of view**, Bo Chen, Alois M. Herkommer, Univ. Stuttgart (Germany) . . . . . .[10335-5]

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

LOCATION: SAAL 1, ICM . . . . . MON 10:00 TO 11:00

Putting a Spin on Photons

Jörg Wachtrup, Univ. of Stuttgart (Germany)

For details, please see page 3, or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

SESSION 2

LOCATION: LEOPOLD . . . . . MON 11:20 TO 12:50

Computational Optics for Imaging and Sensing

Session Chairs: **Pascal Picart,** Univ. du Maine (France); **Hans Peter Herzig,** Ecole Polytechnique Fédérale de Lausanne (Switzerland)

11:20: **Designing optics to reduce digital processing and communication in computational sensors and imagers: a new approach to low-power sensing** *(Invited Paper)*, David G. Stork, Rambus Inc. (USA) . . . . . .[10335-6]

11:50: **Computational wavelength resolution for in-line lensless holography: phase-coded difraction patterns and wavefront group-sparsity**, Vladimir Y. Katkovnik, Tampere Univ. of Technology (Finland); Igor A.

12:10: **Fast physical optics-based simulation of waveguide displays for mixed and virtual reality applications**, Daniel Asoubar, LightTrans International UG (Germany); Christian Hellmann, Wyrowski Photonics UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) .[10335-8]

12:30: **Real-time augmented reality overlay for an energy-efficient car study**, Peter Wozniak, Dan S. Curticapean, Hochschule Offenburg (Germany); Nicolas Javahiraly, ICUBE (France). . . . . .[10335-9]

Lunch Break . . . . . .Mon 12:50 to 14:00

SESSION 3

LOCATION: LEOPOLD . . . . . MON 14:00 TO 15:40

Imaging and Combiner Optics for HMDs I

Session Chairs: **Bernard C. Kress,** Microsoft Corp. (USA); **Hong Hua,** College of Optical Sciences, The Univ. of Arizona (USA)

14:00: **The ideal imaging AR waveguide**, David Grey, WaveOptics (United Kingdom). . . . . .[10335-10]

14:20: **Thin combiner optics utilizing volume holographic optical elements (vHOEs) using Bayfol® HX photopolymer film**, Friedrich-Karl Bruder, Christian Rewitz, Christel Manecke, Thomas Faecke, Günther Walze, Rainer Hagen, Sven Hansen, Thomas Rölle, Enrico Orselli, Covestro AG (Germany) . . [10335-11]

14:40: **Folded optics with birefringent reflective polarizers**, Timothy Wong, Zhisheng Yun, Gregg Ambur, Jo Etter, 3M Co. (USA) . . . . . .[10335-12]

15:00: **Subwavelength optics for new optical combiners: beyond diffractive optics' limitations**, Guillaume Basset, Giorgio Quaranta, Frédéric Zanella, Angélique Luu-Dinh, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) . . . . . .[10335-13]

15:20: **Super-resolution optics for virtual reality**, Dejan Grabovickic, Limbak (Spain); Pablo Benítez, Juan C. Minano, Limbak (Spain) and Univ. Politécnica de Madrid (Spain); Pablo Zamora, Marina Buljan, Bharathwaj A. Narasimhan, Limbak (Spain); Milena I. Nikolic, CeDInt-UPM (Spain); Jesus Lopez, Limbak (Spain); Eduardo Sanchez, CeDInt-UPM (Spain) . . . . . .[10335-14]

Coffee Break . . . . . .Mon 15:40 to 16:10

SESSION 4

LOCATION: LEOPOLD . . . . . MON 16:10 TO 17:50

Imaging and Combiner Optics for HMDs II

Session Chairs: **Arie den Boef,** ASML Netherlands B.V. (Netherlands); **H. Paul Urbach,** Technische Univ. Delft (Netherlands)

16:10: **Mass production of holographic transparent components for augmented and virtual reality applications**, Juan Manuel Russo, Fedor Dimov, Joy Padiyar, Seth A. Coe-Sullivan, Luminit LLC (USA). . . . . .[10335-15]

16:30: **Advanced freeform optics enabling ultra-compact VR headsets**, Pablo Benítez, Juan C. Miñano, Limbak (Spain) and Univ. Politécnica de Madrid (Spain); Pablo Zamora, Dejan Grabovickic, Marina Buljan, Limbak (Spain); Milena I. Nikolic, Univ. Politécnica de Madrid (Spain); Bharathwaj A. Narasimhan, Jorge Gorospe, Jesus Lopez, Limbak (Spain); Eduardo Sanchez, Univ. Politécnica de Madrid (Spain) . . . . . .[10335-16]

16:50: **High collimated coherent illumination for reconstruction of digitally calculated holograms: design and experimental realization**, Alexander V. Morozov, German Dubinin, Sergey Dubynin, Igor Yanusik, SAMSUNG R&D Institute Rus. (Russian Federation); Sun Il Kim, Chil-Sung Choi, Hoon Song, Hong-Seok Lee, Samsung Advanced Institute of Technology (Korea, Republic of); Andrey Putilin, P.N. Lebedev Physical Institute (Russian Federation); Sergey Kopenkin, Yuriy Borodin, Moscow State Technical Univ. of RadioTechnics, Electronics and Automatics (Russian Federation). . . . . .[10335-17]

17:30: **Human-centric optical design for next generation wide FOV AR HMDs**, Bernard C. Kress, Microsoft Corp. (USA). . . . . .[10335-19]

TUESDAY 27 JUNE

SESSION 5

LOCATION: LEOPOLD . . . . . TUE 8:00 TO 9:50

Planar Digital Micro- and Nano-Optics

Session Chairs: **Federico Capasso,** Harvard School of Engineering and Applied Sciences (USA); **Christophe Peroz,** Magic Leap, Inc. (USA)

8:00: **Metasurface polarization optics: chiral holograms and elliptical polarization beam splitters** *(Invited Paper)*, Federico Capasso, Jan Philipp Balthasar Mueller, Robert Charles Devlin, Noah A. Rubin, Benedict Groever, Harvard School of Engineering and Applied Sciences (USA) . . . . . .[10335-20]

8:30: **Novel fabrication methods for nanophotonics**, Stephan Kress, Harvard Univ. (USA) . . . . . .[10335-21]

8:50: **Digital metasurface for wavefront modulation**, Yan Zhang, Capital Normal Univ. (China) . . . . . .[10335-22]

9:10: **Global optimization of complex optical structures using Baysian optimization based on Gaussian processes**, Philipp-Immanuel Schneider, JCMwave GmbH (Germany); Xavier Garcia Santiago, JCMwave GmbH (Germany) and Karlsruher Institut für Technologie (Germany); Carsten Rockstuhl, Karlsruher Institut für Technologie (Germany); Sven Burger, JCMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany) . . . . . .[10335-23]

9:30: **Slot silicon-gallium nitride waveguide in MMI structures based 1x8 wavelength demultiplexer**, Bar Baruch Ben Zaken, Tal Zanzury, Dror Malka, Holon Institute of Technology (Israel) . . . . . .[10335-78]

Coffee Break . . . . . Tue 9:50 to 10:20

SESSION 6

LOCATION: LEOPOLD . . . . . TUE 10:20 TO 12:50

Tunable, Switchable and Reconfigurable Optics

Session Chairs: **Joshua D. Silver,** Univ. of Oxford (United Kingdom); **Pascal Picart,** Univ. du Maine (France)

10:20: **Self-refraction in HMDs through adjustable focus lenses** *(Invited Paper)*, Joshua D. Silver, Univ. of Oxford (United Kingdom). . . . . .[10335-25]

10:50: **A robust liquid crystal device with adjustable deflection and diffraction for multiple applications**, Neal Weinstock, Soliddd Corp. (USA) . . . . . .[10335-26]

11:10: **A high-resolution optical rangefinder using tunable focus optics and spatial photonic signal processing**, Tariq Shamim Khwaja, Mohsin Ali Mazhar, Haris Khan Niazi, Syed Azer Reza, Lahore Univ. of Management Sciences (Pakistan) . . . . . .[10335-27]

11:30: **Arbitrary shaping of ultrafast Bessel beams with a phase-only spatial light modulator**, Ismail Ouadghiri Idrissi, FEMTO-ST (France); Remo Giust, Luc Froehly, FEMTO-ST (France); Maxime Jacquot, Luca Fufaro, FEMTO-ST (France); John M. Dudley, François Courvoisier, FEMTO-ST (France) . . . . . .[10335-28]

11:50: **Calibration and digital correction of aberrations in combined optical systems with interchangeable parts**, Thomas Milde, Carl Zeiss AG (Germany) . . . . . .[10335-29]

12:10: **Adaptive digital stereo microscope to support 3D vision: optomechanical design and experimental validation**, Carsten C. Reichert, Daniel Claus, Alois M. Herkommer, Institut für Technische Optik (Germany) . . . . . .[10335-51]

12:30: **Short-wavelength infrared high resistive photoconductor based on Chalcogenide glasses for OASLM applications**, Asi Solodar, Matvey Kalbanov, Ibrahim Abdulhalim, Ben-Gurion Univ. of the Negev (Israel) . . . . . .[10335-24]

Lunch Break . . . . . Tue 12:50 to 14:00

SESSION 7

LOCATION: LEOPOLD . . . . . TUE 14:00 TO 15:30

Computer-generated Holography

Session Chairs: **Hans I. Bjelkhagen,** Glyndwr Univ. (United Kingdom); **Adrian Travis,** Microsoft Corp. (USA)

14:00: **Large holographic 3D display for real-time computer-generated holography** *(Invited Paper)*, Ralf Häussler, Norbert Leister, Hagen Stolle, SeeReal Technologies GmbH (Germany) . . . . . .[10335-30]

14:30: **3D color reconstructions in single DMD holographic display with LED source and complex coding scheme**, Maksymilian Chlipala, Tomasz Kozacki, Warsaw Univ. of Technology (Poland) . . . . . .[10335-31]

14:50: **Autonomous generation of extended images of dynamic phase objects in a depth volume sample using a simple focusing criterion and K-means clustering**, María-Luisa Cruz-López, Univ. Panamericana (Mexico); Miguel Alcaraz-Rivera, Univ. Panamericana (Mexico); Pinhas Girshovitz, Natan T. Shaked, Tel Aviv University (Israel); Bahram Javidi, University of Connecticut (USA) . . . . . .[10335-33]

15:10: **An optical method for compensating phase discontinuity in a 360-degree viewable tabletop digital holographic display system**, Yongjun Lim, Keehoon Hong, Hayan Kim, Hyon-Gon Choo, Jin-Woong Kim, Minsik Park, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . .[10335-34]

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

SESSION 8

LOCATION: LEOPOLD . . . . . TUE 16:00 TO 17:50

Novel 3D Display Techniques and Technologies

Session Chairs: **Thomas P. Fäcke,** Covestro AG (Germany); **Demetri Psaltis,** Ecole Polytechnique Fédérale de Lausanne (Switzerland)

16:00: **The promises and pitfalls of real-time holographic display** *(Invited Paper)*, Joel S. Kollin, Microsoft Corp. (USA) . . . . . .[10335-36]

16:30: **VR versus LF**, Tibor Balogh, Holografika Kft. (Hungary); Peter A. Kara, WMN Research Group, Kingston University (United Kingdom) . . . . .[10335-37]

16:50: **Volumetric graphics in liquid using holographic femtosecond laser pulse excitations**, Kota Kumagai, Utsunomiya Univ. (Japan); Yoshio Hayasaki, Utsunomiya Univ (Japan) . . . . . .[10335-38]

17:10: **Distortion-free 3D imaging using wavefront shaping**, Martin Teich, Jeremy Sturm, Lars Büttner, Jürgen W. Czarske, TU Dresden (Germany) . . . . . .[10335-39]

17:30: **Autostereoscopic image creation by hyperview matrix controlled single pixel rendering**, Armin Grasnick, FernUniv. in Hagen (Germany) . . . . . .[10335-40]

WEDNESDAY 28 JUNE

SESSION 9

LOCATION: LEOPOLD . . . . . WED 8:10 TO 9:50

Digital Optics for Structured Illumination

Session Chairs: **Andreas Hermerschmidt,** HOLOEYE Photonics AG (Germany); **Pascal Picart,** Univ. du Maine (France)

8:30: **Holographically generated structured illumination for cell stimulation in optogenetics**, Felix Schmieder, Lars Büttner, Jürgen W. Czarske, TU Dresden (Germany); Maria Leilani Torres, Leibniz Univ. Hannover (Germany); Alexander Heisterkamp, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Simon Klapper, Volker Busskamp, DFG-Ctr. for Regenerative Therapies Dresden (Germany). . . . . .[10335-42]

8:50: **Design and quality metrics of point patterns for coded structured light illumination with diffractive optical elements in optical 3D sensors**, Ralf Vandenhouten, Technische Hochschule Wildau (Germany); Andreas Hermerschmidt, HOLOEYE Photonics AG (Germany); Richard Fiebelkorn, Technische Hochschule Wildau (Germany). . . . . .[10335-43]

9:10: **Structured illumination 3D microscopy using adaptive lenses and multimode fibers**, Jürgen W. Czarske, Katrin Philipp, Nektarios Koukourakis, TU Dresden (Germany) . . . . . .[10335-44]

9:30: **Imaging and pattern projection through multicore fibers using the memory effect**, Nicolino Stasio, Donald B. Conkey, Christophe Moser, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . .[10335-45]

Coffee Break . . . . . Wed 9:50 to 10:30

OPTICAL METROLOGY/DIGITAL OPTICAL TECHNOLOGIES 2017 PLENARY SESSION

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

Metasurface Diffractive Optics

Federico Capasso, Harvard Univ. (USA)

For details, please see page 3 or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

POSTERS—WEDNESDAY

LOCATION: ICM FOYER . . . . . WED 12:40 TO 14:00

Conference attendees are invited to attend the Optical Metrology Poster Session 2 on Wednesday. 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 12:40 through 13:50 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 5.

Aerial 3D display by use of a 3D-shaped screen with aerial imaging by retro-reflection (AIRR), Nao Kurokawa, Shusei Ito, Hirotsugu Yamamoto, Utsunomiya Univ. (Japan) . . . . . .[10335-18]

Real-time aberration correction simulation of multimode beam by SPGD algorithm, Qiong Zhou, Wenguang Liu, Baozhu Yan, Quan Sun, Shaojun Du, National Univ. of Defense Technology (China) . . . . . .[10335-56]

CPU architecture for a fast and energy-saving calculation of convolution neural networks, Florian Knoll, Stephan H. Hussmann, Michael Grelcke, Fachhochschule Westküste Heide (Germany) . . . . . .[10335-58]

Method of synthesis of abstract images with high self-similarity, Nikolai V. Matveev, Galina E. Romanova, Sergey A. Shcheglov, Tatiana A. Koneva, ITMO Univ. (Russian Federation). . . . . .[10335-59]

A study of wavefront coding technique applied to next generation digital optical system, Qi-Feng Lee, National Central Univ. (Taiwan); Yi Chin Fang, National Kaohsiung First Univ. of Science and Technology (Taiwan); Cheng-Mu Tsai, National Chung Hsing Univ. (Taiwan) . . . . . .[10335-60]

Analytic functions of optical choppers for Gaussian laser beams, Nicolina Pop, Politehnica Univ. of Timisoara (Romania); Octavian Cira, Aurel Vlaicu Univ. of Arad (Romania); Virgil-Florin Duma, Aurel Vlaicu Univ. of Arad (Romania) and Politehnica Univ. of Timisoara (Romania) . . . . . .[10335-61]

Adding polarimetric imaging to depth map using improved light field camera 2.0 structure, Xuanzhe Zhang, Hefei Institutes of Physical Science (China) and National Univ. of Defense Technology (China) and Univ. of Science and Technology of China (China); Shaojun Du, Yi Yang, Yu Cao, National Univ. of Defense Technology (China) . . . . . .[10335-62]

Modified 3D time-of-fligth camera for object separation in organic farming, Florian Knoll, Stephan H. Hussmann, Fachhochschule Westküste Heide (Germany) . . . . . .[10335-63]

Calibration between a 3D camera and an aerial information screen, Shusei Ito, Nao Kurokawa, Hirotsugu Yamamoto, Utsunomiya Univ. (Japan)[10335-64]

Power Estimation of Martial Arts Movement Using 3D Motion Capture Camera, Mohamad Zubir Mat Jafri, Nurzaidi Azraai, Ahmad Afiq Sabqi Awang Soh, Univ. Sains Malaysia (Malaysia) . . . . . .[10335-65]

Development of an optical radar for distance learning crevices Mars, Leonid Smirnov, Victoria A. Ryzhova, Alexsandr S. Grishkanich, ITMO Univ. (Russian Federation) . . . . . .[10335-66]

Measuring the volume of brain tumour and determining its location in T2-weighted MRI images using hidden Markov random field: expectation maximization algorithm, Mohamad Zubir Mat Jafri, Univ. Sains Malaysia (Malaysia); Hayder Saad Abdulbaqi, Univ. Sains Malaysia (Malaysia) and College of Education Al-Qadisiya (Iraq); Kussay N. Mutter, Ahmad Fairuz Omar, Iskandar Shahrim Mustafa, Univ. Sains Malaysia (Malaysia) . . . . . .[10335-67]

An efficient method to improve speed-of-focus of electronically tunable lenses for optical systems using Gaussian beams, Muhammad Assad Arshad, Friedrich-Schiller-Univ. Jena (Germany); Ahsan Muhammad, Syed Azer Reza, Lahore Univ. of Management Sciences (Pakistan) . . . . . .[10335-68]

MEMS and agile optics-based dual-mode variable optical power splitter with no moving parts, Tariq Shamim Khwaja, Hamid Suleman, Syed Azer Reza, Lahore Univ. of Management Sciences (Pakistan) . . . . . .[10335-69]

A multispectral telescopic systems with a variable magnification, Ivan Tarasov, Helen A. Tsyganok, ITMO Univ. (Russian Federation) . . . . .[10335-70]

Ghosting images processing methods for dynamic aberration detection in imaging systems, Yi Yang, Hefei Institutes of Physical Science (China) and National Univ. of Defense Technology (China) and Univ. of Science and Technology of China (China); Quan Sun, National Univ. of Defense Technology (China); Xuanzhe Zhang, Hefei Institutes of Physical Science (China) and National Univ. of Defense Technology (China) and Univ. of Science and Technology of China (China); Shaojun Du, Baozhu Yan, National Univ. of Defense Technology (China) . . . . . .[10335-71]

Optical power transmission in a polygon mirror-based swept source optical coherence tomography system, Mike Everson, Univ. of Kent (United Kingdom); Virgil F Duma, Universitatea Aurel Vlaicu (Romania); George M Dobre, University. of Kent (United Kingdom) . . . . . .[10335-72]

A digital filtering algorithm fast implementation based on Catapult C, Zhang Ye, Beijing Institute of Space Mechanics and Electricity (China) . . . . . .[10335-73]

Medical photoacoustic beamforming using minimum variance-based delay multiply and sum, Moein Mozaffarzadeh, Ali Mahloojifar, Mahdi Orooji, Tarbiat Modares Univ. (Iran, Islamic Republic of) . . . . . .[10335-74]

An adaptive weighted Lp metric for optimal margin classification: a theoretical framework for optical remote sensing data, Sawon Pratiher, Indian Institute of Technology Kanpur (India); Vigneshram Krishnamoorthy, National Institute of Technology, Tiruchirappalli (India); Paritosh Bhattacharya, National Institute of Technology, Agartala (India) . . . . . .[10335-75]

Statistical classifiers on multifractal parameters for optical diagnosis of cervical cancer, Sabyasachi Mukhopadhyay, IISER Kolkata, India (India); Sawon Pratiher, IIT Kanpur (India); Rajeev Kumar, NIT Allahabad (India); Vigneshram Krishnamoorthy , NIT Trichy (India); Asima Pradhan, IIT Kanpur (India); Nirmalya Ghosh, Prasanta K. Panigrahi, IISER Kolkata (India)[10335-76]

SESSION 10

LOCATION: LEOPOLD . . . . . WED 14:10 TO 15:30

Digital Optics for Sensing and Metrology

Session Chairs: **Yoshio Hayasaki,** Utsunomiya Univ. (Japan); **Reinhard Voelkel,** SUSS MicroOptics SA (Switzerland); **Bernard C. Kress,** Microsoft Corp. (USA)

14:10: **High-resolution LCOS microdisplay with sub-kHz frame rate for high performance, high precision 3D sensor**, Grigory Lazarev, Stefanie Bonifer, Philip Engel, HOLOEYE Photonics AG (Germany); Daniel Höhne, Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . . .[10335-35]

14:30: **Sinusoids-assisted empirical mode decomposition profilometry**, Chenxing Wang, Feipeng Da, Southeast Univ. (China). . . . . .[10335-46]

14:50: **Phase unwrapping in fast fringe projection profilometry**, Haixia Wang, Rou Peng, Xicheng Yang, Zhejiang Univ. of Technology (China) . . . . . .[10335-47]

15:10: **Feature Selection from Hyperspectral Imaging for Guava Fruit Defects Detection**, Mohamad Zubir Mat Jafri, Sou Ching Tan, Univ. Sains Malaysia (Malaysia) . . . . . .[10335-48]

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

SESSION 11

LOCATION: LEOPOLD ..... WED 16:00 TO 17:40

Digital Holography for Sensing and Imaging

Session Chairs: **Dirk Kanngiesser,** Seebright inc (USA); **Norbert Kerwien,** Carl Zeiss AG (Germany)

16:00: **Axial-resolution in depth from focus digital holography**, Joseph van Rooij, Jeroen Kalkman, Technische Univ. Delft (Netherlands) . . . . . .[10335-50]

16:20: **Optical sound wave recording by digital holography with heterodyne technique**, Osamu Matoba, Xiangyu Quan, Sudheesh K. Rajput, Kouichi Nitta, Kobe Univ. (Japan); Yasuhiro Awatsuji, Kyoto Institute of Technology (Japan). . . . . .[10335-52]

16:40: **Spectrally resolved digital holography using a white light LED**, Daniel Claus, Giancarlo Pedrini, Dominic Buchta, Wolfgang Osten, Univ. Stuttgart (Germany) . . . . . .[10335-53]

17:00: **Ptychographic phase retrieval by applying hybrid input-output (HIO) iterations sequentially**, Sander Konijnenberg, Technische Univ. Delft (Netherlands); Wim Coene, ASML Netherlands B.V. (Netherlands); Silvania Pereira, Hendrik P. Urbach, Technische Univ. Delft (Netherlands) . . .[10335-54]

17:20: **Imaging particles in full 3D parallax mode with two-wavelength off-axis Fresnel holography**, Pascal Picart, Univ. du Maine (France); Soumaya Kara-Mohammed, Univ. du Maine (France) and Univ. Ferhat Abbas de Sétif (Algeria); Larbi L. Bouamama, Univ. Ferhat Abbas de Sétif (Algeria) .[10335-55]

LOCATION: LEOPOLD .....17:40 TO 17:50

Closing Remarks

INDEX OF AUTHORS, CHAIRS, AND COMMITTEE MEMBERS

Bold = SPIE Member

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GENERAL INFORMATION

Registration

Onsite Registration and Badge Pick-up Hours

ICM Foyer West

Sunday 25 June 2017 . . . . . 10:00 to 17:00 hrs.

COURSE registration opens 7:45 hrs.

Monday 26 June 2017. . . . . 7:30 to 17:00 hrs.

Tuesday 27 June 2017 . . . . . 8:00 to 17:00 hrs.

Wednesday 28 June 2017 . . . . . 8:30 to 17:00 hrs.

Thursday 29 June 2017 . . . . . 8:30 to 16:00 hrs.

Course Registration

Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Course prices include applicable taxes. Onsite, please go to SPIE Cashier to pick up your course materials.

Multiple facilities may be used for courses; allow yourself enough time to register, pick up your materials, and possibly walk to a nearby facility before your course begins.

Conference Registration

Includes admission to all conference sessions, plenaries, panels, technical events, and poster sessions; admission to the Exhibition; Welcome Reception; and a choice of online proceedings or online collections.

SPIE Member, SPIE Student Member, and Student Pricing

- SPIE Members receive conference and course 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.

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.

Receipt 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 €50 service charge for processing refunds. Requests for refunds must be received by 14 June 2017; 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, 1st Floor

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 BO, where M-Events will be available to help with any questions during registration hours.

Optical Metrology and Digital Optical Technologies Joint Poster Sessions

Tuesday Poster Session 1:
Conf. 10329, 10332

Wednesday Poster Session 2:
Conf. 10330, 10331, 10333, 10335

Thursday Poster Session 3:
Conf. 10334

Location: ICM Foyer

Please see each conference programme for specific session timing.

All symposium attendees are invited to attend Optical Metrology and Digital Optical Technologies Poster Sessions provided as an opportunity to enjoy networking while reviewing poster papers. Attendees are encouraged to review the high-quality papers that are presented in this alternate format and to interact with the poster authors. Poster authors must be present at their posters at the Poster Session times designated for their conference to answer questions and interact with the poster session audience.

Set up and removal times for each of the Poster Session days.

Your poster may be displayed any time after setup time and must be removed by the break-down time noted below:

Tuesday 27 June
Conf. 10329, 10332
Setup—Monday, 13:00 hrs
Break-down—Tuesday, 17:00 hrs

Wednesday 28 June
Conf. 10330, 10331, 10333, 10335
Setup—Wednesday, 10:00 hrs
Break-down—Thursday, 16:30 hrs

Thursday 29 June
Conf. 10334
Setup—Wednesday, 10:00 hrs
Break-down—Thursday, 16:30 hrs

Poster presenters may post their poster papers starting at the announced times for each conference, and present them during their respective conference Poster Session. Any papers left on the boards following the poster removal time 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 during their assigned times to answer questions from attendees. For specific Poster Session times, please see the individual conference programs. Attendees are requested to wear their conference registration badges to the poster sessions.

Onsite Services

Internet Access

ICM foyer areas

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

SPIE Conference and Exhibition 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 Publications

SPIE Exhibition Stand, Hall B2, Stand 138.

Browse the latest SPIE Press Books and proceedings.

Urgent Message Line

Messages for attendees can be left by calling +49 89 949 57011. 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.

Food and Beverage Services

Coffee Breaks

ICM Foyers / H4 Hotel München Messe

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 H4 Hotel München Messe 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".

Car Rental

Hertz

Call the Hertz International Reservation Center at 1-800-654-3001 in the USA, your local Hertz Reservations Center, or Franz-Josef-Strauss Airport in Munich at +49 (0) 89 9788614 to receive a special discount for SPIE. Reservations may also be placed on-line at www.hertz.com. You will receive 15% off qualifying affordable rates at participating locations in Munich, Germany.

Be sure to identify yourself as a SPIE attendee. The PC# below 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- July 15, 2017.

Optical Metrology
Attendee Discount
15% OFF
Qualifying Affordable Rates
PC#137480

Important Rental Information

The SPIE discount is available at participating locations in Munich, GE.

The 15% Discount applies to rentals on Affordable Rates from June 15- July 15, 2017.

Reservations must be made at least 24 hours prior to vehicle pickup, using the PC# on the coupon. No CDP discounts apply.

Minimum rental period is 3 days.

Offer includes Compact and above both manuals and automatic (includes basic/standard cars - not vans, premium, luxury, collections, etc.).

Discount does not apply to taxes, intercity drop charges, insurance or optional services.

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Normal intercity rules and rate restrictions apply.

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SPIE. OPTICAL METROLOGY PROCEEDINGS

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Available as part of registration:

Online Proceedings Volume—access to a single conference proceedings volume via the SPIE Digital Library. Available as papers are published.

Online Proceedings Collection—access to multiple related proceedings volumes via the SPIE Digital Library. Available as papers are published.

Conference Attendees: You may purchase additional online proceedings volumes for €60 each. Print conference proceedings volumes are also available; see pricing below.

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To access your proceedings:

- Go to **http://spiedigitallibrary.org** and sign in. If you do not have an SPIE account, create one using the email address you used to register for the conference.
- Click the My Account link at the top of the page, then find the My Conference Proceedings tab, which will show your available proceedings volumes.

You can also access this content via your organization's SPIE Digital Library account.

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Online Proceedings Volumes

Conference Attendees: The price for additional online proceedings volumes is €60 each.

Product Order Number		Volume Title/Volume Editors	Price for separate purchase
Print Volume	Online Volume		Meeting Attendees
10329	**DL 10329**	**Optical Measurement Systems for Industrial Inspection X** *Peter Lehmann, Wolfgang Osten, Armando Albertazzi Gonçalves*	**€165.00**
10330	**DL 10330**	**Modeling Aspects in Optical Metrology VI** *Bernd Bodermann, Karsten Frenner, Richard M. Silver*	**€95.00**
10331	**DL 10331**	**Optics for Arts, Architecture, and Archaeology VI** *Luca Pezzati, Piotr Targowski*	**€60.00**
10332	**DL 10332**	**Videometrics, Range Imaging, and Applications XIV** *Fabio Remondino, Mark R. Shortis*	**€60.00**
10333	**DL 10333**	**Optical Methods for Inspection, Characterization, and Imaging of Biomaterials III** *Pietro Ferraro, Simonetta Grilli, Monika Ritsch-Marte, Christoph K. Hitzenberger*	**€85.00**
10334	**DL 10334**	**Automated Visual Inspection and Machine Vision II** *Jürgen Beyerer, León Puente*	**€60.00**

Online Proceedings Collections

Product Order Number	Collection Title/Included Volumes (See next page for volume titles and editors)	Price for separate purchase Meeting Attendees
DLC656	**SPIE Optical Metrology 2017** *Volumes #: 10329, 10330, 10331, 10332, 10333, 10334*	**€ 191**

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- Click the My Account link at the top of the page, then find the My Conference Proceedings tab, which will show your available proceedings volumes.

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Online Proceedings Volumes

Conference Attendees: The following online volume is included with your paid registration.

Product Order Number		Volume Title/Volume Editors	Price for separate purchase
Print Volume	Online Volume		Meeting Attendees
10335	**DL 10335**	**Digital Optical Technologies 2017** *Bernard C. Kress, Wolfgang Osten, H. Paul Urbach*	**€95.00**

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- A manuscript (minimum 6 pages, maximum 20 pages) for any accepted oral, invited, keynote, or poster presentation will be submitted for publication in the *Proceedings of SPIE* in the SPIE Digital Library. Some SPIE events have other requirements that the author is made aware of at the time of submission.
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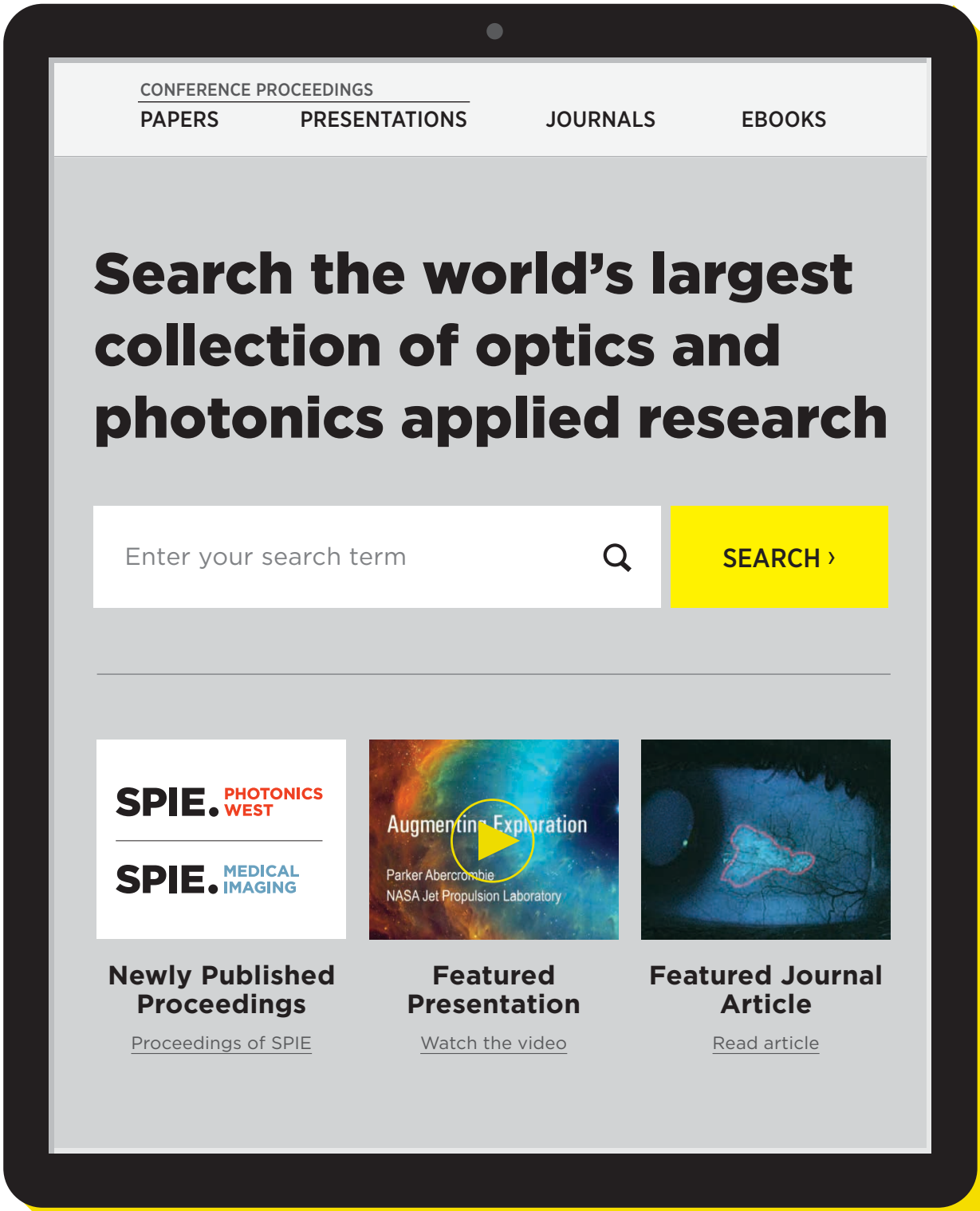

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