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

and

DIGITAL OPTICAL TECHNOLOGIES
A conference focused on the components, systems design, and applications of emerging digital optical technologies.

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**SPIE. OPTICAL METROLOGY**

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**SPIE. DIGITAL OPTICAL TECHNOLOGIES**

A 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).

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EOS
OPTICAL TECHNOLOGIES

LITM 2019
INTERNATIONALES CONGRESS CENTER
FLOOR PLANS

ROOMS AT THE ICM AND B0

2nd Floor

Room 21a/b
Room 22a/b
Room Osterseen

1st Floor

Room 12a/b
Room 13a/b
Room 11a/b
Room 14b
Room 14a
Room 14c
Speakers’ Service

Ground Floor

Room 1 – Auditorium
Room 2
Room 4a/b
Room 5
Room 3
ICM Foyer
Hall B0
Poster Sessions

WiFi Lounge
Catering
Information Desk
ROOMS AT THE EXHIBITION HALL A1

1. Room 1 “Albert Einstein”, Ground Floor, Hall A1
2. Room 2 “Emmy Noether”, Ground Floor, Hall A1
3. Room 3 “Theodore Maiman”, Ground Floor, Hall A1
4. Room 4 “Emmett Leith”, Ground Floor, Hall A1
5. Room 5 “Marie Curie”, Ground Floor, Hall A1
6. Room 6 “Charles Townes”, Ground Floor, Hall A1

7. Room 7 “Dennis Gabor”, Ground Floor, Hall A1
8. Room 8 “Gustav Hertz”, Ground Floor, Hall A1
9. Room 9 “Arthur Schawlow”, Ground Floor, Hall A1
10. Room 10 “Wilhelm Röntgen”, Ground Floor, Hall A1
11. Room A11 “Gordon Gould”, 1st Floor, Hall A1
12. Room A12 “Max Born”, 1st Floor, Hall A1
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Listening to the universe with gravitational waves

Karsten Danzmann
Max Planck Institute for Gravitational Physics and Leibnitz Univ. Hannover (Germany)

Biography: Prof. Karsten Danzmann is director at Max Planck Institute for Gravitational Physics (Albert Einstein Institute) and head of the division Laser Interferometry and Gravitational Wave Astronomy. He is Director of the Institute of Gravitation Physics at Leibniz Universität Hannover.

Prof. Danzmann is one of the most important scientists in the study of gravitational waves: His groundbreaking work has enabled the direct detection of gravitational waves, thus ushering in a new era of astrophysical research. For his merits he was honoured with the Edison Volta Prize of the European Physical Society and the Stern-Gerlach Medal of the German Physical Society (DPG) in 2018. Karsten Danzmann has already been presented with the Fritz Behrens Foundation Science Prize 2016, the Lower Saxony Science Award 2016, the Körber European Science Prize 2017, and the Otto Hahn Prize 2017. As a member of the LIGO Scientific Collaboration he was awarded the Special Breakthrough Prize in Fundamental Physics, the Gruber Cosmology Prize, and the Princess of Asturias Award.

Light field image processing: overview and research problems

Christine Guillemot
INRIA, France

Light field imaging is becoming increasingly popular thanks to recent advances in acquisition devices. By capturing light rays emitted along different directions, light fields yield a rich description of the scene, enabling post-capture processing capabilities that can be appealing for a variety of applications. However, the huge volume of high-dimensional light field data is an obvious issue for storage, transmission but also for fast processing. In addition, acquisition devices designed so far to capture light fields come with some technological limitations that translate into trade-offs between angular and spatial resolution. This talk will review fundamentals in light field imaging, the main capturing devices and will present fundamental problems in light field image processing.

Biography: Christine Guillemot is currently Director of Research at INRIA (Institut National de Recherche en Informatique et Automatique) in France. She holds a PhD degree from ENST (Ecole Nationale Supérieure des Télécommunications) Paris (1992). From 1985 to 1997, she has been with France Telecom working in the areas of image and video compression for multimedia and digital television. From 1990 to mid 1991, she has worked as visiting scientist at Bellcore Bell Communication research) in the USA. Her research interests are signal and image processing, and in particular 2D and 3D image and video processing for various problems (compression, super-resolution, inpainting, classification). She has co-authored 25 patents, has published 80 journal publications and 190 publications in peer reviewed international conferences. She received an ERC advanced grant for a project on computational imaging (2016-2021).

She has served in both the IEEE MMSP technical committee (2005-2008), and the IEEE IVMS technical committee (2015-2016). She has been Associate Editor for IEEE Trans. on Image Processing (from 2000 to 2003 and from 2014 to 2016), for IEEE Trans. on Circuits and Systems for Video Technology (2004-2006), IEEE Trans. on Signal Processing (2007-2009), for the Eurasip journal on image communication (2010-2016), and member of the IEEE journal on selected topics in signal processing (2013-2016). She is currently senior area editor for IEEE Trans. on Image Processing and senior member of the steering committee of IEEE Trans. on Multimedia. She is IEEE fellow since January 2013.

World of Photonics Congress-wide Nobel Plenary Session

Monday 24 June 2019 · 18:00 - 19:00 · Location: ICM, Saal 1

Passion for Extreme Light

Gerard Mourou
Ecole Polytechnique (France); 2018 Physics Nobel Prize Laureate

The Nobel Prize in Physics 2018 was awarded to Arthur Ashkin, Gérard Mourou and Donna Strickland. Strickland and Mourou received the award “for their method of generating high-intensity, ultra-short optical pulses”. Prof. Gérard Mourou was the founding Director of the Center for Ultrafast Optical Science at the University of Michigan. For forty years, he has pioneered the field of ultrafast lasers and their applications in scientific, engineering and medical disciplines. He is also the initiator of the Extreme Light Infrastructure (ELI) in Europe. He is a fellow of The Optical Society and a fellow of the Institute of Electrical and Electronics Engineers and SPIE. Prof. Mourou is a member of the National Academy of Engineering. Currently he is Distinguished Professor Emeritus from the University of Michigan and the Ecole polytechnique in Palaiseau, France.

He has been the recipient of the Wood Prize from The Optical Society, the Edgerton Prize from the SPIE, the Sarnoff Prize from the IEEE, the 2004 IEEE/LEOS Quantum Electronics Award, 2005 Willis E. Lamb Award for Laser Science and Quantum Optics, the 2009 Charles Hard Townes Award, te 2016 Berthold Leibinger Zukunftspreis and the 2016 Frederic Ives Meda./Jarus Quinn Prize.
Towards a complete framework for calibration of optical surface and coordinate measuring instruments

Richard Leach
University of Nottingham, United Kingdom

The optics and semiconductor manufacturing industries have well-established calibration infrastructures for optical measurements of surface geometry. These infrastructures are less developed for many precision manufacturing industries that rely on machining of complex surface geometries. Highly complex freeform geometries and textures, as found for example in the automotive, aerospace and medical parts industries, mean that many of the established calibration techniques for optical surface measurements may not be directly relevant. In addition, with the industrial uptake of additive manufacturing techniques, the complexity of the resulting surfaces is leading to new measurement challenges.

It is commonplace in many manufacturing industries to hear users expressing alarm about the incompatibility of optical instruments with contact methods of measuring surface texture and geometry, and these concerns are often borne out in formal comparisons. In many cases, the difference between the results from optical and contact instruments can be explained after critical assessment of the measurement conditions and sample geometries, but the damage has already been done: take up of optical instruments in many manufacturing industries has been slow.

Why the disconnect, why the lack of trust? One of the primary reasons for this disconnect with complex surfaces is the lack of a calibration framework for optical instruments, where calibration is the process of comparing a measurement result to a reference result in order to establish traceability. It is relatively simple to understand and model the physical interaction of a contact probe tip with a surface, but it is not so simple to model the equivalent optical interaction – it is a more complex physics problem.

To try to address this issue in the surface texture measurement community, a framework is being developed that attempts to simplify the problem by introducing a number of common or instrument-independent metrological characteristics – instrument parameters that can be determined with a suitable material measure and procedure, and the resulting parameter values can then be propagated through a measurement model to give an estimate of measurement uncertainty. The framework only applies if certain well-defined assumptions about the measurement scenario are adhered to, but it is a solid start and will significantly enhance the kudos of optical instruments in manufacturing industry.

In the world of optical coordinate measurement, for example with laser triangulation or fringe projection systems, there is work in the standards committees to bring optical instruments into the performance verification framework that has been developed for contact coordinate measuring systems. However, with the exception again of the optics industry, there seems to be little research into how to apply the same equivalence to calibration of such instruments – calibration of optical coordinate measuring systems is not currently being addressed in the standardisation committees but is clearly needed in manufacturing industry. In the contact coordinate measuring system world, substitution can be applied in simple cases and virtual instruments can be used in more complex measurement scenarios, but such virtual instrument models are not widely available for optical instruments nor is it completely obvious how to develop them. The presentation will discuss the philosophy and positive advances that have been made in the development of a metrological characteristics framework for surface texture measuring instruments, research work to plug the gaps in situations when the usual assumptions do not apply and will take a forward look at how the framework might be applied to optical coordinate measuring systems. As Professor Wolfgang Osten once said: “...the transfer of technologies from the laboratory to the industrial environment is often an adventure” – I hope I can present a new chapter in this adventure and give some useful hints about the content of the chapters to come.

Biography: Professor Richard Leach currently holds the Chair in Metrology in the Faculty of Engineering at the University of Nottingham where he has established The Manufacturing Metrology Team to investigate information-rich metrology of surfaces, to support next-generation manufacturing technologies. Drawing on concepts such as machine learning and sensor fusion, his research is changing the approach to quality control in manufacturing.

Prior to his current position, he spent 25 years at the National Physical Laboratory and led a team in surface and nanometrology. He is an internationally recognised researcher in the field of surface topography measurement, particularly in the area of traceability for areal surface metrology, including optical instruments. Richard has developed a range of instruments over his 30 years of metrology research, including both theory and practical developments. Some instruments developed include Fizeau, Michelson, Twyman-Green, homodyne and low coherence interferometers; fringe projection, photogrammetry, and contact stylus systems; and co-ordinate measuring machine probes. He has over 400 publications, including five textbooks. He is the European Editor-in-Chief for Precision Engineering journal. He is a Fellow of the Institute of Physics, the Institution of Engineering & Technology, the Institute of Measurement & Control, the International Society of Nanomanufacturing, a Sustained Member of the American Society of Precision Engineering and a Council Member of the European Society of Precision Engineering & Nanotechnology. Richard is a visiting professor at Loughborough University and the Harbin Institute of Technology.
**SPECIAL EVENTS**

**Students and SPIE Fellows Luncheon**
Monday 24 June 2019 · 12:30 to 14:00
Location: Am See Restaurant, Level 1 ICM

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 24 June 2019 · 19:00 - 21:00
Location: Main Foyer, ICM and Hall BO

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

**Optical Metrology and Digital Optical Technologies Welcome Reception**
Wednesday 26 June 2019 · 19:00 - 21:30
Location: Ratskeller Muenchen, Marienplatz

All attendees are invited to relax, socialise, and enjoy light refreshments. Please remember to wear your conference registration badges. Dress is casual.

**AR VR MR Headset Demos**
Tuesday 25 June 2019 · 9:00 - 17:00
Location: Hall A1, Room 10 Wilhelm Röntgen

Try out the latest virtual reality hardware (from Microsoft Hololens, DigiLens, Dispelix, LightSpace Technologies, SCHOTT, and others). Plus, see the latest in computer-generated holograms (CGH) for 3D displays from the Univ. of Japan.

Go online to reserve a time at spie.org/demos

You must have a technical or exhibition-only badge to access the demos. Max 2 sessions per person, per day.

Questions? Email innovation@spie.org

**SPIE Optical Metrology and SPIE Digital Optical Technologies Joint Poster Sessions**
Tuesday - Thursday 25 - 27 June 2019 · 12:00 - 12:40
Location: ICM, Hall BO

All symposium attendees are invited to attend Digital Optical Technologies and Optical Metrology Joint Poster Sessions provided as an opportunity to enjoy networking while reviewing poster papers.

Please note that the Digital Optical Technologies Conference Poster Session (Conf. 10335) has been scheduled as part of the Wednesday Poster Session 2, and will run from 12:50 to 13:50 hrs.

**TUESDAY POSTER SESSION 1:** Conf. 11056, 11058, 11060 (Optical Metrology)

**WEDNESDAY POSTER SESSION 2:** Conf. 11057, 11059 (Optical Metrology), 11062 (Digital Optical Technologies)

**THURSDAY POSTER SESSION 3:** Conf. 11061 (Optical Metrology)

Attendees are encouraged to review the high-quality papers and 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. Attendees are requested to wear their conference registration badges to the poster sessions.

Please see below for specific conference poster session timing.

**Tuesday 25 June · Poster Session 1**
- Optical Metrology, Conf. 11056 (Opt. Measurement Systems-Industrial Inspection): 13:00 to 14:20
- Optical Metrology, Conf. 11058 (Optics for Arts, Architecture, and Archaeology): 12:30 to 13:10

**Wednesday 26 June · Poster Session 2**
- Digital Optical Technologies, Conf. 11062: 12:50 to 13:50
- Optical Metrology, Conf. 11057 (Modeling Aspects in OM): 11:30 to 12:40
- Optical Metrology, Conf. 11059 (Multimodal Sensing and Artificial Intelligence: Technologies and Applications): 11:30 to 12:40

**Thursday 27 June · Poster Session 3**

Poster Authors, please note the following:

**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. 11056, 11058, 11060
Setup—Monday, 13:00 hrs; Break-down—Tuesday, 17:00 hrs

**Wednesday 28 June** - Conf. 11057, 11059, 11062
Setup—Wednesday, 10:00 hrs; Break-down—Wednesday, 17:00 hrs

**Thursday 29 June** - Conf. 10334
Setup—Thursday, 9:30 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.
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.

Optical Technologies and Architectures for Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) Head-Mounted Displays (HMDs)

SC1218

Course Level: Intermediate
CEU: 0.4 €370 Members | €255 Student Members | €420 Non-Members
Sunday 8:30 to 12:30

The course provides an extensive overview of the current product offerings as well as the various optical architectures, 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 existing systems, as well as the various optical building blocks, as in:
- Display engines including microdisplay panel architectures, scanner based light engines and phase panels
- Optical combiners integrated either in free space or waveguide platforms
- Depth mapping sensors either through structured illumination or time of flight
- Head tracking, gaze tracking and gesture sensors

Emphasis is set on the design and fabrication techniques to provide the best display immersion and comfort:
- Wearable comfort (size/ weight, CG)
- Visual comfort (eye box size and IPD coverage, angular resolution, FOV, distortion, dynamic range, contrast, …)
- Passive and active foveated rendering and peripheral displays
- VAC (Vergence Accommodation Conflict) mitigation through varifocal, multifocal, spatial and temporal light fields and per pixel depth holographic displays.

The features and limitations of current optical technologies addressing such specifications are reviewed.
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. Challenges for next generation systems are reviewed, where immersion and comfort need to be addressed along with consumer level costs requirements.

Finally, the course reviews market analysts’ expectations, projected over the next 5 to 10 years, and lists the main actors (major product design companies, start-ups and optical building block vendors, 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:

- identify the various consumer and enterprise head worn systems available in industry today, defined 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, their advantages and limitations.
- describe 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,
- examine the human visual system, its specifics and limitations.
- identify the limitations of current optical architectures and how some can be overcome by designing the optics around the human visual system.
- describe the feature and functionality requirement for next generation systems, and review the key enabling technologies.
- examine 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 development of Enterprise and Consumer HMDs in all their declination products. Project and project managers involved in defining current and next generation HMD products, technology product roadmaps and next generation optical sub-systems.

INSTRUCTOR
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 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 displays systems, and eventually HUD and HMD displays (smart glasses, AR/VR). Bernard has been specifically involved in the field of micro-optics, wafer scale optics, holography and nanophotonics. He has published half a dozen books and has more than 35 patents granted. He is a short course instructor for the SPIE and has been chair of various SPIE conferences. He is an SPIE fellow since 2013 and 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. on the Hololens project.

Design, Modeling and Fabrication Techniques for Micro-Optics: Applications to Display, Imaging, Sensing and Metrology

SC1217
Course Level: Intermediate
CEU: 0.4 €370 Members | €255 Student Members | €420 Non-Members
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.

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

We will also review in details the basic micro-optics building blocks and the overall architecture of the iPhone X IR human face sensor.

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 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 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 displays systems, and eventually HUD and HMD displays (smart glasses, AR/MR/VR). Bernard has been specifically involved in the field of micro-optics, wafer scale optics, holography and nanophotonics. He has published half a dozen books and has more than 35 patents granted. He is a short course instructor for the SPIE and has been chair of various SPIE conferences. He is an SPIE fellow since 2013 and 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. on the Hololens project.

An Introduction to Deep Learning
SC1275
Course Level: Introductory
CEU: 0.4 €370 Members | €255 Student Members | €420 Non-Members
Sunday 13:30 to 17:30
This course explains basic principles and applications of deep learning. In the first half the principles and history of deep learning and neural networks are explained, followed by many examples of applications of deep neural networks from image classification to deep fakes. In the second half of the course we will build our own basic networks using Google Collaboratory notebooks and will examine some more advanced options such as data augmentation and transfer learning. Anyone who wants to learn more about what deep learning is and how it can be used will benefit from this course.

LEARNING OUTCOMES
This course will enable you to:
• list the basic types of deep learning networks
• list the basic uses that deep networks are currently used for
• list the advantages and disadvantages of using neural networks
• construct a simple neural network using python
• use data augmentation to decrease the amount of data needed for training a neural network
• use transfer learning to make use of pre trained models to train on less data

INTENDED AUDIENCE
Scientists, engineers, technicians, or managers who wish to learn more about deep learning and its applications. Undergraduate training in engineering or science is assumed. To join in the second half of the course a laptop with Chrome browser, a Google account, and some rudimentary python knowledge is needed.

INSTRUCTOR
Maarten Kruithof has worked at TNO in the computer vision group since 2008 and primarily in neural networks and deep learning since 2015. He currently leads a group that applies deep neural network technology to real world problems such as transport and mobility, health care, and industrial and infrastructure inspection. Together with his colleagues, he developed an introductory course on deep learning to teach the basic principles of deep neural networks to new employees, and teaches this course in and outside of TNO. Attendees will need their laptop with Chrome browser and a Google account.
- Optical Measurement Systems for Industrial Inspection
- Modeling Aspects in Optical Metrology
- O3A: Optics for Arts, Architecture, and Archaeology
- Multimodal Sensing and Artificial Intelligence: Technologies and Applications
- Optical Methods for Inspection, Characterization and Imaging of Biomaterials
- Automated Visual Inspection and Machine Vision

Symposium Chairs

Marc P. Georges
Liège Univ. (Belgium)

Jörg Seewig
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Piotr Targowski, Nicolaus Copernicus Univ. (Poland)
CONFERENCE 11056
LOCATION: ICM, 14C


Optical Measurement Systems for Industrial Inspection XI

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

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MONDAY 24 JUNE

SESSION 1

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

Interferometry I

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

8:30: Hot topics in classical interferometry (Invited Paper), Peter J. de Groot, Zygo Corporation (USA) ......................................................... [11056-1]

9:00: Bessel fringes modulation determination by directional spatial carrier phase shifting, Adam R. Styk, Helena Dziubańska, Warszawa University of Technology (Poland) ......................................................... [11056-2]

9:40: Comparison of algorithms determining sign of Bessel function in time averaging interferometry, Helena Dziubańska, Adam R. Styk, Institute of Micromechanics and Photonics, Warsaw University of Technology (Poland) ......................................................... [11056-3]

9:40: Analysis of measurement error caused by swing motion for determining the physical thickness and group refractive index of a large glass panel, Joonhwan Jin, Korea Research Institute of Standards and Science (Korea, Republic of) and Univ. of Science and Technology (Korea, Republic of); Jaeseok Bae, Univ. of Science and Technology (Korea, Republic of); Jungsung Park, Korea Research Institute of Standards and Science (Korea, Republic of) and Univ. of Science and Technology (Korea, Republic of) ......................................................... [11056-4]

11:00: High-NA lensless coherent imager as a building block for a synthetic aperture interferometry array, Jorge García Armenta, Pablo D. Ruiz, Charles R. Cogggrave, Ian S. Park, Jeremy Coupland, Loughborough Univ. (United Kingdom) ......................................................... [11056-5]

12:00: Compact dual-wavelength digital holography using VCSEL technology, Daniel Claus, Igor Alekseenko, Raimund H Gärtner, Institut für Lasertecnologien in der Medizin und Messtechnik, Univ. Ulm (Germany) ......................................................... [11056-6]

12:20: Digital holography for quantification of semiconductor structures, Vismay Trivedi, Nimit Patel, HICS Co. (Korea, Republic of); Mughita Joglekar, Vani Chhinalal, The Maharaja Sayajirao Univ. of Baroda (India); Seonoh Lee, HICS Co. (Korea, Republic of); Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India) ......................................................... [11056-7]

Lunch Break ................................................................. Mon 12:40 to 13:45

SESSION 2

LOCATION: ICM, 14C ................. MON 13:45 TO 15:45

Interferometry II

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

13:45: Topography measurement of glass disk substrates with sub-nanometer resolution, Klaus Freischlad, Chris Koliopoulos, InterOptics, LLC (USA) ......................................................... [11056-8]

14:05: Three-dimensional shape measurement of fine structure by detecting phase distribution of only zeroth order diffraction beam based on speckle interferometry, Yasuhiko Arai, Kansai Univ. (Japan) ......................................................... [11056-9]

14:25: Two-dimensional remote interferometric stage encoder through a single access port using range-resolved interferometry, Kieran B. Wiseman, Thomas Kissinger, Ralph P. Tatam, Cranfield Univ. (United Kingdom)[11056-11]

14:45: Absolute distance measurement of optical path length of non-contact three-dimensional nanoplotter based on normal vector tracing method by tandem white-light interferometer, Jungmin Kang, Takao Kitayama, Ryo Kizaki, Yui Toyoshi, Kota Hashimoto, Osaka Univ. (Japan); Agustinus Winarno, Kiyoshi Takamasu, The Univ. of Tokyo (Japan); Kazuya Yamamura, Endo Katsuyoshi, Osaka Univ. (Japan) ......................................................... [11056-12]

15:05: Differential displacement measurements along a single beam using range-resolved interferometry, Thomas Kissinger, Ralph P. Tatam, Cranfield Univ. (United Kingdom) ......................................................... [11056-13]

15:25: Demodulation for sinusoidal frequency/phase modulation interferometer using artificial harmonic series signal and phase-locked loop, Masato Akiyama, Masato Higuchi, Dong Wei, Nagaoka Univ. of Technology (Japan) ......................................................... [11056-14]

Coffee Break ................................................................. Mon 15:45 to 16:15

WORLD OF PHOTONICS

CONGRESS-WIDE PLENARY SESSION

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

Listening to the universe with gravitational waves

Karsten Danzmann, Max Planck Institute for Gravitational Physics and Leibniz Univ. Hannover (Germany)

Coffee Break ................................................................. Mon 11:00 to 11:15

SESSION 3

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

Digital Holography

Session Chair: Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caiianiello” (Italy)

11:20: Digital holographic imaging for optical inspection in learning-based pattern classification, Han-Yen Tu, Kuang-Chieh Chang, Chinese Culture Univ. (Taiwan); Chau-Jern Cheng, National Taiwan Normal Univ. (Taiwan) ......................................................... [11056-5]
SESSION 4
LOCATION: ICM, 14C ........................ MON 16:15 TO 17:55
Speckle and Shearing Interferometry
Session Chair: Marc P. Georges, Liège Univ. (Belgium)
16:15: Thermography-inspired processing strategy applied on shearingography towards nondestructive inspection of composites. Murielle Kirkove, Yuchen Zhao, Pascal Blain, Jean-François Vanderrije, Marc Georges, Liège Univ. (Belgium). .................................................. [11056-15]
16:35: A robust integration algorithm for out-of-plane displacement field measurements applied to multiple images of shearingography. Estiven Sánchez Barrera, Univ. Federal de Santa Catarina (Brazil); Analucia Vieira Fantin, Daniel P. Willem, Univ. do Estado de Santa Catarina (Brazil); Mauro E. Benedet, Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil). .................................................. [11056-16]
16:55: Shearography inspection of monolithic CFRP composites: finite element modeling approach for assessing an adequate strategy of artificial defects representing delamination. Jean-François Vanderrije, Ctr. Spatial de Liège (Belgium); Hu Xiong, Cédric Lequesne, Samtech (Belgium); Pascal Blain, Marc Georges, Ctr. Spatial de Liège (Belgium). .................................................. [11056-17]

TUESDAY 25 JUNE
SESSION 5
LOCATION: ICM, 14C ........................ TUE 08:30 TO 10:00
Topography Sensors and Measuring Systems
Session Chair: Jörg Seewig, Technische Univ. Kaiserslautern (Germany)
8:30: Scale spanning subnanometer metrology up to ten decades (Invited Paper). Eberhard Manske, Thomas Fröhlich, Roland Füssl, Rostyslav Mastylo, Eberhard Manske, Physikalisch-Technische Bundesanstalt (Germany); Oliver Birli, Ingo Ortlepp, Ulrike Blumröder, Technische Univ. Ilmenau (Germany); Peter Lehmann, Univ. Stuttgart (Germany); Xiang Peng, Shenzhen Univ. (China); Linjie Zhao, Ping Zhou, Ying Yan, Qian Bai, YiQi Wang, Dongming Guo, Dalian Univ. of Technology (China). .................................................. [11056-20]
9:00: Concept for a highly miniaturized endoscopic point distance sensor. Korbinian Prause, Hochschule Kempten (Germany); Simon Thiele, Alois Herkommer, Harald Giessen, Univ. Stuttgart (Germany); Bernd Pinzer, Michael Lohy, Hochschule Kempten (Germany). .................................................. [11056-21]
9:40: Roundness measurement by employing laser Doppler distance sensor and error separation techniques. Shengyu Shi, South China Univ. of Technology (China) and TU Dresden (Germany); Hao Zhang, TU Dresden (Germany); Jinhping Qu, Gang Jin, South China Univ. of Technology (China); Robert Kuschmierz, Jürgen Czarske, TU Dresden (Germany). .................................................. [11056-23]
Coffee Break ........................................... Tue 10:00 to 10:30

SESSION 6
LOCATION: ICM, 14C ........................ TUE 10:30 TO 12:00
Resolution Enhancement Techniques
Session Chair: Eberhard Manske, Technische Univ. Ilmenau (Germany)
11:00: Light-sample interaction in microsphere enhanced 2D super-resolution imaging. Gõran Makoni, Ivan Kassamakov, Univ. of Helsinki (Finland); T. Vainikka, Nanoej Inc (Finland); Timo Arstila, Nanoej Inc (Finland); Edward Haeggström, Univ. of Helsinki (Finland). .................................................. [11056-25]
11:20: Microsphere-assisted imaging of sub-diffraction-limited features. Sébastien Marbach, Stéphane Perrin, Paul Montgomery, Manrel, Sylvain Lecler, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France). .................................................. [11056-26]
11:40: Label-free 3D super-resolution nanoscopy, Ivan Kassamakov, Gõran Makoni, Univ. of Helsinki (Finland); Mikka Järvinen, Nanoej Inc (Finland); Anton Nolvi, Univ. of Helsinki (Finland); Tuomas Vainikka, Peeka Raatikainen, Timo Arstila, Tuomo Ylitalo, Nanoej Inc (Finland); Ilona Ninca, Univ. of Helsinki (Finland); Kristian Ahlers, Nanoej Inc (Finland); Edward Haeggström, Univ. of Helsinki (Finland). .................................................. [11056-27]
Lunch Break ........................................... Tue 12:00 to 13:00

POSTERS-TUESDAY
LOCATION: ICM, HALL B0 ........................ TUE 13:00 TO 14:20
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 14:20 hrs on Thursday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/x6513.xml. (Follow the Special Events link)

Wavelength-switchable Fizeau interferometry and its applications. Shijie Liu, Qi Liu, You Zhou, Xueke Xu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China); Zhourou Wu, Jin Chen, Ming Huang, ZC Optoelectronic Technologies, Ltd. (China) and Anhui Province Key Lab. of Non-Destructive Evaluation (China). .................................................. [11056-75]
Light field three-dimensional measurement. Zhewei Cai, Xiaoli Liu, Muhua Liao, Wenhao He, Shenzhen Univ. (China); Giancarlo Pedrini, Wolfgang Osten, Stuttgart (Germany); Xiang Peng, Shenzhen Univ. (China). .................................................. [11056-76]
Measurement of wavefront curvature using computer-generated Fourier holograms. George Krass, Michael Kovalenko, Sergey Odinokov, Nikita Steepuro, Bauman Moscow State Technical Univ. (Russian Federation); Yury Glukhov, ELTA, Ltd. (Russian Federation). .................................................. [11056-77]
Physical-optics investigation of light coupling into fiber and micro-optical sensors. Huiling Zhong, Friedrich-Schiller-Univ. Jena (Germany); Site Zhang, Light-Trans International UG (Germany); Wenxiu Wang, Friedrich-Schiller-Univ. Jena (Germany); Christian Hellmann, Wyrowski Photonics UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany). .................................................. [11056-78]
Surface roughness measurement accuracy analysis of grinded silicon wafer by white light scanning interferometry (WLISI). Linjie Zhao, Ping Zhou, Ying Yan, Qian Bai, YiQi Wang, Dongming Guo, Dalian Univ. of Technology (China). .................................................. [11056-80]
Non-destructive and real-time optical inspection for lens size using swept source optical coherence tomography. Pingjing Jia, hong zhou li, Xin’ian Jiaotong Univ. (China); Jini jiao li, No.203 Research Institute of China Ordnance Industries (China); MeiQi Fang IV, Yuwei Qin V, Xin’ian Jiaotong Univ. (China). .................................................. [11056-81]
Optical form measurement system using a line-scan interferometer and distance measuring interferometers for run-out compensation of the rotational object stage. Joerg Riegeling, Univ. Kassel (Germany); Gerd Ehrat, Physikalisch-Technische Bundesanstalt (Germany); Peter Lehmann, Univ. Kassel (Germany). .................................................. [11056-83]
Dynamic speckle inspection with raw data compression. Elena V. Stoykova, Branimir Ivanov, Institute of Optical Materials and Technologies (Bulgaria); Kwan-Jung Oh, Joong Ki Park, Electronics and Telecommunications Research Institute (Korea, Republic of). .................................................. [11056-84]
Motionless and fast measurement technique for obtaining the spectral diffusion efficiencies of a grating, Sheng Wang, Jinnao Shao, Shiwei Liu, Shanghai Institute of Optics and Fine Mechanics (China); Zhongliang Wu, Jin Chen, Ming Huang, ZC Optoelectronic Technologies, Ltd (China). [11056-86]

Influence of test bench parameters on determination of CMOS-cameras feature, Ba Min Dinh, Valery V. Korotaev, Sergey N. Yarishhev, Anton A. Manare, Ivan Hektor, Vituske, ITMO University (Russian Federation). [11056-87]

Near real-time digital holographic imaging on conventional central processing unit, Vira R. Besaga, Anton V. Saetchnikov, Nils C. Gerhardt, Andreas Ostendorf, Martin R. Hofmann, Ruhr-Univers. Bochum (Germany). [11056-88]

Optic-electronic multi-system for measuring the positions of the reflecting panels on the mirror of the large radio-telescope, Igor A. Konyakhin, Minh Hao Tong, ITMO University (Russian Federation). [11056-89]

Investigation of the device for limiting the turn of the converter case, Alexander Semenov, ITMO University (Russian Federation). [11056-91]

Bright high harmonic generation around 30 nm and 10 nm for seeding full coherent XFEL, Zhiyuan Lou, Yingzhong Zheng, Luoyang Zhang, Jiaqi Wu, Zhiyuan Lou, Xinlin Li, Zhizhan Xu, Shanghai Institute of Optics and Fine Mechanics (China). [11056-92]

Impact damage characterization in CFPF plates using PCA and MEEMD decomposition methods in optical low-temperature thermography phase images, Bernando Casamiro Fonseca, Olivia Norte, Humberto, Estevan Sánchez Barrera, Univ. Federal de Santa Catarina (Brazil); Christian R. Baldi, Federal University of ABC (Brazil); Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil); Robert H. Schmitt, RWTH Aachen University (Germany). [11056-93]

Turning a machine vision camera into a high precision position and angle encoder: nanoGPS-OxO, Olivier Acher, Thiam Liem Nguyen, HORIBA (France). [11056-94]

Improving the accuracy of detail positioning using machine vision methods and the use of preprocessing algorithms, Evgeny A. Semenishchev, Viacheslav Voronin, Moscow State University of Technology “Stankin” (Russian Federation); Sos Agaian, College of State Staten Island, The City University of New York (USA). [11056-95]

Nonlinear noise analysis in a long-haul fiber-optic sensing system, Chunyan Cao, Hu Chen, National University of Latvia, Shahid Beheshti University Iran, (Iran, Islamic Republic of). [11056-96]

Wafer-level inspection platform on high-volume photonic integrated circuits for drastic reduction of testing time, Tomohisa, NTT Device Technology Labs. (Japan); Yoshihisa Maeda, Shinji Matsuo, Hiroshi Fukuda, Nippon Telegraph and Telephone Corp. (Japan). [11056-97]

Ultra-large dynamic signal detection method based on combined 3x3 optical fiber interferometer, Shuindong Xiong, Chunyan Cao, Qiong Yao, Fuyin Wang,核算 Hou, Hu Chen, Changxiang Linghu, National University of Defense Technology (China). [11056-98]

Comparative analysis of feedback methods in reconstruction algorithms for multiple-scattering holographic tomography, Juliana Winnik, Damian Suski, Tomasz Kozacki, Warsaw University of Technology (Poland). [11056-99]

A conceptual study of infrared and visible-light image fusion methods for three-dimensional object reconstruction, Bernardo Casamiro Fonseca de Oliveira, Vicente Borges, Tiago Loureiro Figaro, da Costa Pinto, Univ. Federal de Santa Catarina (Brazil). [11056-100]

Study of the non-uniformity of sensitivity distributed over photomultiplier active area influence on the operation of the photometric mode for a separate x-ray luminous diamond, Ivan S Nekrylov, Sergey V. Mednikov, Aleksander N. Chertov, ITMO University (Russian Federation); Joel J. P. C. Rodrigues, ITMO University (Russian Federation) and National Institute of Telecommunications (Brazil); Valery V. Korotaev, Timofeev N. Alexander, ITMO University (Russian Federation). [11056-101]


Opto-electronic system for measurement the position of Millimeter's space telescope segments of main mirror, Gleb Vasiliev, Igor A. Konyakhin, ITMO University (Russian Federation). [11056-103]

Measurement and calculation of solid-state matrix photomultiplier's polarization parameters, Anastasiya Lobanova, Daria Drozdova, Victoria Rybchenko, ITMO University (Russian Federation). [11056-104]

Optical laser reflection borometry, Jan Holecek, Czech Technical University in Prague (Czech Republic). [11056-105]

Characterization the effect of acetone gas concentration on polymeric tapered optical fiber sensor, Ormid Reza Ranjarban Naenia, Ali Barandak, Mohammad Mehdi Tahmasebi, Hamid Latifi, Shahid Beheshti University (Iran, Islamic Republic of). [11056-106]

Spectrally-resolved white-light phase-shifted interferometry for 3D measurements of multilayer films, Young-Sik Ghim, Hyun-Gyo Rhee, Korea Research Institute of Standards and Science (Korea, Republic of). [11056-107]


Optical method of on-line temperature monitoring on the melt surface in laser metallic deposition technology, Yuri N. Zavalov, Institute of Laser and Information Technologies of the RAS (Russian Federation); Vladimir D. Dubrov, Institute of Laser and Information Technologies of the RAS (Russian Federation); Anatolii V. Zuev, Institute of Laser and Information Technologies of the RAS (Russian Federation) and Russian Academy of Sciences. [11056-109]

3D shape measurement of specular objects by phase measuring, Juan Zhao, Zhan Song, Felfei Gu, Shenzhen Institutes of Advanced Technology (China). [11056-110]

Camera calibration method of optical system for large field measurement of hot forgings in heavy industry, Jakub Hurnik, Aneta Zatocilova, David Patousel, Brno University of Technology (Czech Republic). [11056-111]

Optical methods of aberration correction in optical systems of autocollimators, Dmitrii I. Egrov, ITMO University (Russian Federation). [11056-112]

Original methods of aberration correction in optical systems of autocollimators, Dmitrii I. Egrov, ITMO University (Russian Federation). [11056-113]

Micro- and nanofabrication technologies using the nanopositioning and nanomeasuring machines, Laura Weidenfeller, Martin R. Hofmann, Johannes Kirchner, Shradhita Supretti, Ivo W. Rangelow, Stefan Sinzinger, Eberhard Marquardt, Technische Universität Ilmenau (Germany). [11056-114]

Removal of monotonically increasing or decreasing phase ambiguity in retrieved phase by Riesz transform method in digital interferometric techniques, Yassine Tounsi, Univ. Chouaib Doukkali (Morocco); Manoj Kumar, Kobe Univ. (Japan); Atleieamni Nestam, Univ. Chouaib Doukkali (Morocco); Fernando Mendoza-Santoyo, Centro de Investigaciones en Optica, A.C. (Mexico). [11056-115]


Automatic control system of combustion processes based on the methods of contactless optical spectroscopy, Mikhaili V. Vagayan, Oleg D. Moskaliev, Vasily I. Kazakov, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation). [11056-117]

High-accuracy piston error measurement with a large capture range based on coherent diffractive interference, Young-Sik Ghim, Hyung-Soon Zhang, Young-Sik Ghim, Hyung-Soon Zhang, and Hyun-Gyo Rhee, Seoul National University of Technology. [11056-118]

Analysis of the methods of monitoring the parameters of the submount level roughness of an optical component's surface based on scattered laser radiation measurement, Dmitry Denisov, Bauman Moscow State Technical University (Russian Federation); Magomed A. Abdulkidyrov, Peter Luy, “Lytkarino Optical Glass Factory”, JSC (Russian Federation); Nikolay Baryshnikov, Tamara Kuznetsova, Bauman Moscow State Technical University (Russian Federation). [11056-119]

Adaptive optics test bench for predictive wavefront correction, Lidia A. Bolbasova, V. E. Zuev Institute of Atmospheric Optics (Russian Federation). [11056-120]

Spectrally-resolved white-light phase-shifted interferometry for 3D measurements of multilayer films, Young-Sik Ghim, Hyun-Gyo Rhee, Korea Research Institute of Standards and Science (Korea, Republic of). [11056-121]

All-weather pulse laser altimeter for measuring low altitudes above the sea surface, Nguyen Tung, Evgeny Lebedkov, ITMO University (Russian Federation). [11056-122]

Reliability results of a fully automated robust x-y stage measurement unit for precise light distribution measurement, Steffen Reisch, Daniel Aichert, Thomas Schaeufele, Burak Oezdemir, Hamza Soeylemez, Daniel Stankic, Hochschule Pforzheim (Germany). [11056-123]

Noise reduction of digital holography using speckle correlation properties, Hideki Funamizu, Muroran Institute of Technology (Japan); Jun Uozumi, Hokkai-Gakuen University (Japan); Yoshihisa Azu, Muroran Institute of Technology (Japan). [11056-124]
Development of absolute angular encoder design on coordinate photodetectors, Knirli S. Povarov, Sergey Mitrofanov, ITMO Univ. (Russian Federation) .................................................. [11056-144]

Adaptive windowed Fourier transform filtering method for speckle fringe patterns, Jing Liu, Weinan normal Univ. (China); Guoqing Zhou, Beibeil Liu, Northwestern Polytechnical University (China) .................................................. [11056-145]

Coordinate mapping of the primary mirror vertex in a space telescope by using a CGH and theodolites, Haoyong KFhn, Ho-Soon Yang, Ji-Won Kang, Korea Research Institute of Standards and Science (Korea, Republic of) .................................................. [11056-146]

A new method for measuring target reflectivity, Hongfui Wu, Huazhong Univ. of Science and Technology (China); Fei Hu, Huazhong Univ. of Science and Technology (China) and National Key Lab. of Science and Technology on Multi-Spectral Information Processing (China); Jinlong Su, Yan Hu, Peng Fu, Huazhong Univ. of Science and Technology (China) .................................................. [11056-147]

Highly repetitive low-coherence interferometry with time-stretch technique, Masaharu Hoshikawa, Katsushiro Ishii, The Graduate School for the Creation of New Photonics Industries (Japan); Takeshi Makino, Takahiro Hashimoto, Hideaki Furukawa, Naoya Wada, National Institute of Information and Communications Technology (Japan) .................................................. [11056-148]

Contrast determination in phase-shifting algorithms for interferograms with arbitrary steps and additive noise, G astonishingly, Avi, Unv. de la Republica Uruguay (Uruguay) .................................................. [11056-149]

Two-shot fringe pattern phase demodulation using the extreme value of interference with Hilbert-Huang per-filtering, Hangying Zhang, Hong Zhao, Xin Jieadong Univ. (China); Jinlei Zhao, No.203 Research Institute of China Ordnance Industries (China); Chenchun Wang, No.203 Research Institute of China Ordnance Industries (China) .................................................. [11056-150]

High resolution measurement of freeform wavefront by using self-imaging based sensor, Lalit Mohan Pant, Instrument Design and Development Ctr. (India) and Indian Institute of Technology Delhi (India); Kamal K. Pant, Dal Ramu Burada, Instrument Design and Development Ctr. (India); Amitava Ghosh, Instruments Research & Development Establishment (India); Gufran Sayeed Khan, Changda Shaikher, Instrument Design and Development Ctr. (India). .................................................. [11056-151]

Development of an illumination module for stroboscopic phase-shift interferometry on MEMS devices, Luz Guilherme de Medeiros Ventura, Steffen Wolschke, Fraunhofer-Institut für Photonische Mikrosysteme (Germany); Christoph Skupsch, Fraunhofer-Institut für Photonische Mikrosysteme (Germany) and Robert Bosch Kft. (Hungary); Dirk Berndt, Fraunhofer-Institut für Photonische Mikrosysteme (Germany) .................................................. [11056-152]

Sensitivity of an image-plane digital holography interferometer for the measurement of pile-up, Matias R. Viotti, Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil); Denis Boing, Rodrigo Błódm, Centro Univ. de Brusque - UNIFEDE (Brazil) .................................................. [11056-153]

Measurement system of characteristics of compensation devices by the autocollimation method, Valeria Portnova, INSTRUMENT DESIGN AND DEVELOPMENT ESTABLISHMENT OF INDIA (India) and Indian Institute of Science and Technology Delhi (India); Dhan Ramu Burada, Kamal K. Pant, Indian Institute of Technology Delhi (India); Dhan Ramu Burada, Kamal K. Pant, Indian Institute of Technology Delhi (India). .................................................. [11056-154]

Freeform optics alignment strategy and its impact in the development of precision freeform optics, Vinod Mishra, CSIR - Central Scientific Instruments Organisation (India); Dali Ramu Burada, Kamal K. Pant, Indian Institute of Technology Delhi (India); Vinod Mishra, CSIR - Central Scientific Instruments Organisation (India); Sunil Nigam, CSIR - Central Scientific Instruments Organisation (India); Sunil Nigam, CSIR - Central Scientific Instruments Organisation (India) .................................................. [11056-155]

Application of immersion method for measuring freeform surfaces, Ksenia Livova, Bauman Moscow State Technical University (Russia); and P. N. Lebedev Physical Institute of the RAS (Russian Federation); Viktoriya Kaidarkarova, Bauman Moscow State Technical University (Russian Federation); Anastasia Perevoznikova, Bauman Moscow State Technical University (Russian Federation) and P. N. Lebedev Physical Institute of the RAS (Russian Federation); Vladislav Druzhin, Bauman Moscow State Technical University (Russian Federation) .................................................. [11056-156]

### Conference 11056

Characterization of thermal absorption and nonlinear absorption in KDP/DKD crystals with different orientations, Xiaokang Peng, Yuan-an Zhao, Dawei Li, Guohang Hu, Long Zhang, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) .................................................. [11056-125]

High resolution topography sensors in a multisensor measuring setup, Sebastian Ghegner, Peter Lehmann, Univ. Kassel (Germany) .................................................. [11056-126]

Measurement of the refractive index of a transparent film using interferometry, Yon Jin Lee, Seung Ho Han, Sung Yong Ahn, Wooyong Song, Ouchu Shin, Soo-Bang Park, University of Macau (Mac.) .................................................. [11056-127]

Multi degree-of-freedom position sensing by combination of laser speckle correlation and range-resolved interferometry, Thomas O. H. Charrett, Sebastian Hagemeier, Peter Lehmann, Univ. Kassel (Germany). .................................................. [11056-128]

Automatic and accurate full-view registration method for 3D scanning system, Wei Xu, Guolin Univ. of Electronic Technology (China); Feifei Gu, Zhan Song, Juan Zhao, Shenzhen Institutes of Advanced Technology (China); Jun Li, School of Electronic Engineering and Automation (China) .................................................. [11056-130]

3D shape measurement in the presence of interferences by light stripe triangulation with additional geometric constraints, Yang Xu, Jihong Jiang, Yunfan Wang, Xudong Li, Beihang Univ. (China) .................................................. [11056-131]

Analysis of sub-pixel laser spot detection in laser triangulation systems, Patrick Kienle, Elif Nallar, Michael H. köhler, Martin Jakobi, Alexander W. Koch, Technische Univ. Munchen (Germany) .................................................. [11056-132]

Digital holographic microscopy for thickness characterization using synthesized partially coherent holograms, Marta Mikula, Juan Martinez-Carranza, Tomas Kozacki, Warsaw Univ. of Technology (Poland) .................................................. [11056-133]

Nonlocal means variants filtering methods for speckle noise reduction in digital speckle pattern interferometric fringes, Yassine Tounsi, Univ. Chouaib Doukkali (Morocco); Marouf Kobe, Kobe Univ. (Japan); Abdekkrim Nassim, Univ. Chouaib Doukkali (Morocco); Fernando Mendoza-Santoyo, Centro de Investigaciones en Optica, A.C. (Mexico) .................................................. [11056-134]

Polarization analysis of the object wave using FMCW digital holography, Masayuki Yokota, T. Ishikawa, N. Aoki, Shimane Univ. (Japan) .................................................. [11056-135]

A hybrid method for velocity field of fluid flow estimation based on optical flow, Grzegorz Sphat, Grzegorz Sphat, Wroclaw Univ. of Science and Technology (Poland) .................................................. [11056-136]

Interferometer for large convex optical aspheric surfaces testing, Alexandra E. Gavlina, STICA U.S. RAS (Russian Federation); Vlasidis I. Bathevev, Scientific and Technological Ctr. of Unique Instrumentation RAS (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation); Denis A. Novikov, All-Russian Scientific Research Institute for Optical & Physical Measurements (Russian Federation); Maria V. Sergeeva, Scientific and Technological Ctr. of Unique Instrumentation RAS (Russian Federation) .................................................. [11056-137]

A demodulation method with high stability for interferometric type vector fiber hydrophone, Qingkai Hou, Fuyin Wang, Qiong Yao, Shuidong Xiong, National Univ. of Defense Technology (China) .................................................. [11056-138]

Determination of paraxial focal length of lens using Strehl definition measurement, Antonin Mady, R. Noval, Pavel Noval, Petr Pokorny, Filip Šmejkal, Czech Technical Univ. in Prague (Czech Republic) .................................................. [11056-139]

Contactless optical spectroscopy methods in the tasks of monitoring physical and technological processes in extreme conditions, Vasily I. Kazakov, Oleg Moskalev, Arthur Parusak, Mikhail A. Vaganov, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) .................................................. [11056-140]

Experimental light scattering by optical fibers: system design and testing, Grzegorz Sphat, Grzegorz Sphat, Wroclaw Univ. of Science and Technology (Poland) .................................................. [11056-141]

Alignment analysis and verification plan of freeform mirrors in linear astigmatism-free three-mirror system (LATFMS), Yujun Kim, Jinhun Kim, Jeong-Yeol Han, Korea Astronomy and Space Science Institute (Korea, Republic of); Woonjin Park, Sooljong Pak, Kyung Hee Univ. (Korea, Republic of); Seunghyuk Chang, Ctr. for Integrated Smart Sensors (Korea, Republic of); Byeongi Gong, Jeong, Hwan-Jin Choi, Geon-Hee Kim, Korea Basic Science Institute (Korea, Republic of) .................................................. [11056-142]

Direct monochromatic optic control system of the thickness of thin-film interference coatings applied in vacuum, Yuriy Proskovsky, Dmitry Denisov, Bauman Moscow State Technical Univ. (Russian Federation); Oleg Proskovsky, Aleksandr Budnev, Technologiya (Russian Federation) .................................................. [11056-143]
**CHAPTER 1056**

**SESSION 7**

**LOCATION:** ICM, 14C  
**TUE 14:20 TO 15:20**

**High-speed Techniques**

Session Chair: **Peter J. De Groot**, Zygo Corporation (USA)

14:20: **Double pulse LED illumination for phase detection in RGB-interferometry.** Markus Schake, Peter Lehrmann, Univ. Kassel (Germany) ................................................................. [11056-28]

14:40: **Full-field, high-frequency, heterodyne interferometry for dynamic metrology based on phase detection using a modified time-of-flight camera.** John B. Mitchell, Compass Optics Ltd. (United Kingdom) and Glynwer Innovations Ltd. (United Kingdom); Gareth W Roberts, Mathowy Cyl Ltd (United Kingdom); Paul C. T. Rees, Wrexham Glyndwr University (United Kingdom) ................................................................. [11056-29]

15:00: **GPU-based digital image correlation system for real-time strain-controlled fatigue and strain field measurement.** Andreas Blug, Fraunhofer-Institut für Physikalische Messtechnik (Germany); David J. Regina, Stefan Eckmann, Melanie Senn, Chris Eberi, Fraunhofer-Institut für Werkstoffmechanik (Germany); Alexander Bertz, Daniel Carl, Fraunhofer-Institut für Physikalische Messtechnik (Germany) ................................................................. [11056-30]

**Coffee Break** ..................................... **TUE 15:20 TO 16:00**

**SESSION 8**

**LOCATION:** ICM, 14C  
**TUE 16:00 TO 18:00**

**3D Microscopy**

Session Chair: **Paul Montgomery**, Lab. des sciences de l’ingénieur, de l’Informatique et de l’Imagerie (France)

16:00: **Active illumination focus variation.** Carlos Bermudez, Pol Martinez, Cristina Cadevall, Roger Argas, Sensoraf-Tech, S.L. (Spain) ................................................................. [11056-31]

16:20: **Optical measurement of ground cylinder lead angle.** Peter J. de Groot, Michael Schmidt, Leslie L. Deck, Zygo Corporation (USA) ................................................................. [11056-32]

16:40: **User-oriented evaluation of the metrological characteristics of areal surface topography measuring instruments.** Daniel Francis, Helius Efinger, Felix Ströhr, Julian Hering, Georg von Freymann, Jörg Seewig, Technische Universität Kaiserslautern (Germany) ................................................................. [11056-33]

17:00: **Correction of surface error occurring in microlenses characterization performed by optical profilers.** Jereny Béguelin, SUSS MicroOptics SA (Switzerland); Torald Noell, Reinhard Voelkel, SUSS MicroOptics SA (Switzerland) ................................................................. [11056-34]

17:20: **The use of parabolic mirrors in combined low-coherence and confocal refractive index measurement.** Daniel Ford, Jonathan M. Hallam, Ralph P. Tatam, Cranfield University (United Kingdom) ................................................................. [11056-35]

17:40: **Novel chromatic confocal differential interference contrast prototype.** Johannes Belker, National Taiwan University (Taiwan) and Technische Universität Ilmenau (Germany); Hsiu-Wen Liu, National Taiwan University (Taiwan); Eberhard Manske, Technische Universität Ilmenau (Germany); Liang-Chia Chen, National Taiwan University (Taiwan) ................................................................. [11056-36]

**WEDNESDAY 26 JUNE**

**SESSION 9**

**LOCATION:** ICM, 14C  
**WED 8:30 TO 10:00**

**Structured Illumination Techniques I**

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

8:30: **Deflectometry (Invited Paper).** Jan Burke, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany) ................................................................. [11056-37]

9:00: **Hybrid telecentric triangulation sensor system with real-time field-dependent deconvolution.** Andreas Fauthaber, Univ. Stuttgart (Germany); Marc Grone, Tobias Haist, Institut für Technische Optik, Univ. Stuttgart (Germany); Christof Prüß, Institut für Technische Optik (Germany); Youssef Baroud, Univ. Stuttgart (Germany); Wolfgang Osten, Institut für Technische Optik, Univ. Stuttgart (Germany); Sven Simon, Univ. Stuttgart (Germany) ................................................................. [11056-38]

9:20: **Structured light sensor with telecentric stereo camera pair for measurements through vacuum windows.** Rüdiger Beermann, Lorenz Quentin, Markus Kästner, Eduard Reithmeier, Institut für Mes- und Regelungstechnik, Leibniz Universität Hannover (Germany) ................................................................. [11056-39]

9:40: **3D shape from thermal patterns: investigation of projection parameters in simulation and experiment.** Martin Landmann, Stefan Heist, Institut für Angewandte Physik, Friedrich-Schiller-Universität Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Peter Kühnstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Technische Universität Ilmenau (Germany) ................................................................. [11056-40]

**Coffee Break** ..................................... **WED 10:15 TO 10:30**

**SESSION 10**

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

**Structured Illumination Techniques II**

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

11:00: **Automatic camera calibration and sensor registration of a multi-sensor fringe measurement system using hexapod positioning.** Sebastian Metzner, Tino Hausotte, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany) ................................................................. [11056-41]

11:20: **Extrinsic calibration of a 3D sensor based on an array projector and a single camera.** Eugene Wong, Stefan Heist, Christian Bräuer-Burchardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Andreas Stark, Institute of Applied Optics, Friedrich-Schiller-Universität Jena (Germany); Holger Babovsky, Richard Kowarschik, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ................................................................. [11056-42]

11:40: **3D multispectral imaging system for contamination detection.** Chen Zhang, Maik Rosenberger, Technische Universität Ilmenau (Germany); Gunther Notni, Technische Universität Ilmenau (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ................................................................. [11056-43]

12:00: **Full-field deflectometry for optical characterization of high-precision mirrors.** Philippe Antoine, Arno Bouwens, Luc Boussameare, LABMDA-X sa (Belgium); Vincent Moreau, Benoît Borjaret, Ksenia Sharshavina, AMOS Ltd. (Belgium) ................................................................. [11056-44]

**Lunch Break** ..................................... **WED 12:50 TO 13:50**

**SESSION 11**

**LOCATION:** ICM, 14C  
**WED 13:50 TO 15:30**

**Light Scattering Techniques**

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

13:50: **Heterodyne detection system for nanoparticle detection using coherent Fourier scatteringmetry.** Dmytro Koloven, Roland C. Horsten, Silviana F. Pereira, Technische Universität Delft (Netherlands) ................................................................. [11056-45]

14:10: **Determination of optical fiber layer parameters by inverse evaluation of lateral scattering patterns.** Gunnar Claussen, Werner Blöhm, Jade Hochschule (Germany) ................................................................. [11056-46]

14:30: **High-resolution Czerny-Turner scatterometer for BRDF measurements.** Felix Koch, Carl Zeiss Jena GmbH (Germany); Matthias Zilk, Friedrich-Schiller-Universität Jena (Germany); Mike Schnabel, Tiltman Glasier, Carl Zeiss Jena GmbH (Germany) ................................................................. [11056-47]

14:50: **Recent development in BTDF/BRDF metrology on large-scale lambertian-like diffusers, application to on-board calibration units in space instrumentation.** Emmanuel Mazé, Céline Michel, Sara Marcotte, Lionel Clermont, Benoît Manguet, Jérôme Jacobs, Isabelle Domken, Yvan Stockman, Ctr. Spatial de Liège (Belgium) ................................................................. [11056-48]

15:10: **Spatially resolved optical strain measurements on high-speed fiber reinforced polymer rotors.** Julian Lich, Tino Wollmann, Angelos Filipatos, Maik Gude, Robert Kuschmierz, Jürgen Czarske, TU Dresden (Germany) ................................................................. [11056-49]

**Coffee Break** ..................................... **WED 15:30 TO 16:00**
SESSION 12
LOCATION: ICM, 14C ..................... WED 16:00 TO 18:00
Measurement of Optical Components I: Asphere and Freeform Measurement

Session Chairs: Oliver W. Fähnle, FISBA AG (Switzerland); Sven Schröder, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany)

16:00: Approaches for a destructive measurement method of subsurface damages, Michael Seiler, Ernst-Abbe-Hochschule Jena (Germany) .............................................. [11056-161]
16:20: Grazing incidence interferometry for testing rough asperics, Sergej Rothau, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Klaus Mantel, Max-Planck-Institut für die Physik des Lichts (Germany); Johannes Schneider, Norbert Lindlein, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) .............................................. [11056-50]
16:40: Investigation of non-uniformity of classically polished fused silica surfaces via laser-induced breakdown spectroscopy, Christoph Gerhard, HAWK Hildesheim Holzminden Göttingen (France) .............................................. [11056-162]
17:00: Tilted wave interferometer in common path configuration: challenges and realization, Rolf Beisswanger, Christof Pruss, Institut für Technische Optik, Univ. Stuttgart (Germany); Christian Schöber, TU Dresden (Germany); Antonia Harsch, Wolfgang Osten, Institut für Technische Optik, Univ. Stuttgart (Germany) .............................................. [11056-51]
17:20: Measurement and correction of two-sided freeform optical elements with combined tactile-optical metrology equipment, Nils Heidler, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) .............................................. [11056-52]
17:40: Measurement of mid-spatial frequency errors on freeform optics using deflectometry, Todd F. Blalock, Brittany D. Cox, Brian Myer, Optimax Systems, Inc. (USA) .............................................. [11056-53]

THURSDAY 27 JUNE
SESSION 13
LOCATION: ICM, 14C ..................... THU 08:30 TO 10:00
Measurement of Optical Components II

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

8:30: Testing highly-sophisticated aspheric and cylindrical surfaces (Invited Paper), Rainer Schulmman, Berliner Glas KGaA Herbert Kubatz GmbH & Co. (Germany) .............................................. [11056-54]
9:00: Self calibrating Hartmann-type wavefront sensor, Jean-Michel Aasfour, Andreas Vogler, Disptic GmbH (Germany) .............................................. [11056-55]
9:20: Precise measurement of unknown and known freeform surfaces using Experimental Ray Tracing, Tobias Binkele, David Hilbig, Mahmoud Essameldin, Thomas Henning, Friedrich Fleischmann, Hochschule Bremen Univ. of Applied Sciences (Germany); Walter Lang, University of Bremen (Germany) .............................................. [11056-56]
9:40: Interferometric measurement of local radii of curvature for aspheric surface using an IDP, Maria Elizabeth Percino-Zacarias, Fermin-Salomon Granados-Agustin, Instituto Nacional de Astrofisica, Optica y Electronica (Mexico); Daniel Aguirre-Aguirre, Brenda Villalobos-Mendoza, Univ. Autonoma de Mexico (Mexico); Alejandro Cornejo-Rodriguez, Instituto Nacional de Astrofisica, Optica y Electronica (Mexico) .............................................. [11056-57]
Coffee Break .............................................. Thu 10:00 to 10:30

SESSION 14
LOCATION: ICM, 14C ..................... THU 10:30 TO 12:30
Hyperspectral Imaging and Spectroscopic Techniques

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

10:30: Setup and evaluation of a static imaging Fourier transform spectrometer for the mid-infrared spectral range, Michael H. Köhler, The-Thien Nguyen, Patrick Kienle, Xingchen Dong, Alexander W. Koch, Technische Univ. München (Germany) .............................................. [11056-58]
10:50: An approach to combined multispectral reflectorless distance measurement and material probing, David Salido-Monzú, Andreas Wieser, ETH Zürich (Switzerland) .............................................. [11056-59]
11:10: Precise thickness measurement and comparison of step-shaped microfluidic channel mold using optical interferometry, Junjiao Park, Korea Research Institute of Standards and Science (Korea, Republic of) and Univ. of Science and Technology (Korea, Republic of); Jaeseok Bae, Univ. of Science and Technology (Korea, Republic of); Jonghan Jin, Korea Research Institute of Standards and Science (Korea, Republic of) and Univ. of Science and Technology (Korea, Republic of) .............................................. [11056-60]
11:30: Hyperspectral imaging microscopy for thickness measurement and surface characterization of layered MoS2, Xingchen Dong, Michael H. Köhler, Martin Jakobi, Alexander W. Koch, Technische Univ. München (Germany) .............................................. [11056-61]
11:50: Realization of a LIBS-based, temporally and spatially resolved welding control, Max Neumann, Tobias Baselt, Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) and Westsächsische Hochschule Zwickau (Germany); Alexander Kabardiladi-Virkoski, Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany); Yves Winkler, Peter Hartmann, Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) and Westsächsische Hochschule Zwickau (Germany) .............................................. [11056-62]
12:10: Rotational Raman spectroscopy for in situ temperature and composition determination in reactive flows, Leo Bahr, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) and Technische Univ. Bergakademie Freiberg (Germany); Franz J. T. Huber, Stefan Will, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Andreas S. Braeuer, Technische Univ. Bergakademie Freiberg (Germany) .............................................. [11056-63]
Lunch Break .............................................. Thu 12:30 to 13:40

SESSION 15
LOCATION: ICM, 14C ..................... THU 13:40 TO 15:40
In-process and In-situ Measurements

Session Chair: Xiang Peng, Shenzhen Univ. (China)

13:40: Automated pump-probe microscope to observe laser ablation on a picosecond scale, Fabian Meyer, Mario Böhler, Andreas A. Brand, Jan F. Nekarda, Fraunhofer-Institut für Solare Energiesysteme (Germany) .............................................. [11056-64]
14:00: Significances and challenges of the innovative emerging metrology methodologies to the newest technology nodes, Hong Chen, XTAL Inc. (USA) .............................................. [11056-65]
14:20: Fluorescence laser scanner for in-line inspection of functional coatings in metal processing industries, Philipp Holz, Albrecht Brandenburg, Fraunhofer-Institut für Physikalische Messtechnik (Germany) .............................................. [11056-66]
14:40: Automated inline visual inspection and 3D measuring in electrode manufacturing, Andreas Frommmecht, Martin Schmauder, Laura Boonen, Carsten Glanz, Fraunhofer-Institut für Prozessstechnik und Automatisierung (Germany) .............................................. [11056-67]
15:00: Innovative system for automated measurement of the distribution of the length of natural fibres, Stefan J. Rinner, Michael Kahl, Carsten Ziolek, NTB Interstaatliche Hochschule für Technik Buchs (Switzerland); Hubert Schmid, IST AG (Switzerland) .............................................. [11056-68]
15:20: Imaging detection and classification of particulate contamination on structured surfaces, Jan Schütz, Alexander Blättermann, Peter Kozlowski, Albrecht Brandenburg, Fraunhofer-Institut für Physikalische Messtechnik (Germany) .............................................. [11056-69]
Coffee Break .............................................. Thu 15:40 to 16:00
SESSION 16

LOCATION: ICM, 14C  .................. THU 16:00 TO 18:00

Nondestructive Testing and Fault Detection

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

16:00: Development of an experimental setup and a study for the comparison between optical properties and the subjective perception of a quality of a display surface, Theresa Puder, Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany); Florian Rudek, Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) and Westsächsische Hochschule Zwickau (Germany); Christopher Taudt, Alexander Kabardiladi-Virkovski, Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) .................. {11056-69}

16:20: Diameter quantification of through holes in pipelines hidden by protective layers of composite materials using instantaneous shearography simultaneously in three shearing directions, Tiago Bortoli, Analucia V. Fantin, Estiven S. Carrera, Mauro E. Benedet, Daniel P. Willemann, Armando Albertazzi Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil) .................. {11056-70}

16:40: Photoacoustic inspection of CFRP using an optical microphone, Janez Rus, Ctr. Baustoffe und Materialprüfung, Technische Univ. München (Germany); Balthasar Fischer, XARION Laser Acoustics GmbH (Austria); Christian U. Grosse, Ctr. Baustoffe und Materialprüfung, Technische Univ. München (Germany) .................. {11056-71}

17:00: Development of a convolutional autoencoder using deep neuronal networks for defect detection and generating ideal references for cutting edges, Abdullah Karatas, Dorothea Kölsch, Samuel Schmidt, Matthias Eifler, Jörg Seewig, Technische Univ. Kaiserslautern (Germany) .................. {11056-72}

17:20: SS-OCT for automated composite manufacturing quality control, Guy Lamouche, National Research Council Canada (Canada); Gil Lund, Fives Lund LLC (USA); Steven Roy, Bruno Gauthier, Marc Palardy-Sim, Maxime Rivard, Christian Padoleau, Jihua Chen, Jean-Pierre Monchalin, Ali Yousefpour, National Research Council Canada (Canada) .................. {11056-73}

17:40: An automatic visual inspection system to scan outer lenses of automotive rear lamps, Tommaso Fontanot, Univ. degli Studi di Trieste (Italy) and Automotive Lighting Rear Lamps Italia (Italy); Denis Ermacora, Giulio Simonetti, Sebastian Raducci, DataMind S.r.l. (Italy); Erik Vesselli, Univ. degli Studi di Trieste (Italy) and Istituto Officina dei Materiali (Italy); Sara Paroni, Automotive Lighting Rear Lamps Italia (Italy) .................. {11056-74}

Modeling Aspects in Optical Metrology VII

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); Sven Burger, Konrad-Zuse-Zentrum für Informationstechnik (Germany); Peter Evanschitzky, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); Liveli Fu, Univ. Stuttgart (Germany); Wolfgang Holzapfel, DR. JOHANNES HEIDENHAIN GmbH (Germany); Norbert Kernwien, Carl Zeiss AG (Germany); Rainer Königs, Physikalisch-Technische Bundesanstalt (Germany); Stefanie Kroker, Physikalisch-Technische Bundesanstalt (Germany); Johannes Ruoff, Carl Zeiss SMT GmbH (Germany); Thomas Siefeke, Physikalisch-Technische Bundesanstalt (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany)

MONDAY 24 JUNE

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION

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

Listening to the universe with gravitational waves

Karsten Danzmann, Max Planck Institute for Gravitational Physics and Leibniz Univ. Hannover (Germany)

See details page 6.

Coffee Break ..................................... Mon 11:00 to 11:15

JOINT SESSION

LOCATION: ICM, ROOM 2 ............... MON 11:15 TO 12:45

SPIE Optical Metrology-EQEC 2019

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

Joint Session between SPIE Conference 11057 and CLEO EQEC 2019

11:15: Numerical optimization of resonant photonic devices (Invited Paper), Martin Hammerschmidt, Lin Zschiedrich, Philipp-Immanuel Schneider, Felix Binkowski, JCMwave GmbH (Germany); Sven Burger, Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany); [11057-101]

11:45: Lensless metrology for semiconductor lithography at EUV (Invited Paper), Iacopo Mochi, Paul Scherrer Institut (Switzerland); [11057-102]

12:15: Model for and with nanoptics (Invited Paper), Thomas Pertsch, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer Institute for Applied Optics and Precision Engineering IOF (Germany) and Max Planck School of Photonics (Germany); [11057-103]

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

LOCATION: ICM, 12B ..................... MON 14:00 TO 15:50

SESSION 1

INTERFEROMETRY I

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

14:00: Modeling the misalignment error in a solar system simulator for rotationally shearing interferometer (Invited Paper), Marja Strojnik Scholl, Centro de Investigaciones en Óptica, A.C. (Mexico); [11057-1]

14:30: Fractional Fourier ridges for demodulation of interferograms with quadratic phase, Jinsin Wu, Mingenfu Lu, Chenchen Ji, Pe-Hang Li, Feng Zhang, Ran Tao, Beijing Institute of Technology (China); [11057-2]

14:50: Suppression of nonlinear optical frequency sweeping in frequency-scanning interferometry for absolute distance measurement, Zhongwen Deng, Zhigang Liu, Wen Deng, Xingyu Jia, Xi’an Jiaotong Univ. (China); [11057-3]

15:10: Intrinsic surface feature-based subaperture stitching of freestyle wavefront, Kamal K. Pant, Instruments Research & Development Establishment (India); Dali R. Burada, Indian Institute of Technology Delhi (India); Vinod Mishra, CSIR - Central Scientific Instruments Organisation (India); Amitava Ghosh, Instruments Research & Development Establishment (India); Gufran S. Khan, Chandra Shakher, Indian Institute of Technology Delhi (India); [11057-4]

15:30: Adjustable accurate phase shifter for phase-shifting interferometry, Cruz Meneses-Fabian, Benemerita Univ. Autónoma de Puebla (Mexico); Rosaura Kantun-Montiel, Gildardo Pablo Lemus-Alonso, Univ. de Montemorelos (Mexico); [11057-5]

Coffee Break ..................................... Mon 15:50 to 16:20

SESSION 2

LOCATION: ICM, 12B ..................... MON 16:20 TO 18:10

Optical Materials/Imaging and Microscopy

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

16:20: Modeling of bulk materials and nanostructures for applications in high-precision optical metrology (Invited Paper), Stefanie Kroker, Physikalisch-Technische Bundesanstalt (Germany) and Technische Univ. Braunschweig (Germany); Florian Bruns, Johannes Dickmann, Physikalisch-Technische Bundesanstalt (Germany); Walter Dickmann, Jan Meyer, Technische Univ. Braunschweig (Germany); Donald MacLeod, David Henry, UK Astronomy Technology Ctr. (United Kingdom); Peter MacKay, Gooch & Housego PLC (United Kingdom); Marc Sorel, Univ. of Glasgow (United Kingdom); Robert Lamb, Leonardo MW Ltd. (United Kingdom); David Cumming, Univ. of Glasgow (United Kingdom); [11057-6]

16:50: Modeling aspects for high-precision absorption measurements, Walter Dickmann, Technische Univ. Braunschweig (Germany); Johannes Dickmann, Florian Bruns, Stefanie Kroker, Physikalisch-Technische Bundesanstalt (Germany) and Technische Univ. Braunschweig (Germany); Carol B. Rojas Hurtado, Physikalisch-Technische Bundesanstalt (Germany); [11057-7]

17:10: Large area metasurface lenses in the NIR region, Mitchell Kenney, James Grant, Danni Hao, Univ. of Glasgow (United Kingdom); Kevin Docherty, Gordon Mills, Kelvin Nanotechnology Ltd. (United Kingdom); Graham Jeffrey, Leonardo MW Ltd. (United Kingdom); Donald MacLeod, David Henry, UK Astronomy Technology Ctr. (United Kingdom); Peter MacKay, Gooch & Housego PLC (United Kingdom); Marc Sorel, Univ. of Glasgow (United Kingdom); Robert Lamb, Leonardo MW Ltd. (United Kingdom); [11057-8]

17:30: Systematic approach on illustrating the challenges represented by optical bidirectional measurements using rigorous simulations, Jan Krüger, Rainer Königs, Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany); [11057-9]

17:50: Model-based confocal fluorescence microscopy measurements of submerged micro geometries, Merlin Mikulwitsch, Axet from Freyberg, Univ. Bremen (Germany); Dirk Stöbener, Universität Bremen (Germany) and MAPEX Centre for Materials and Processes, Univ. Bremen (Germany); Andreas Fischer, Universität Bremen (Germany) and MAPEX Centre for Materials and Processes (Germany); [11057-10]

WORLD OF PHOTONICS CONGRESS: NOBEL PLENARY SESSION

LOCATION: ICM, SAAL 1 ............... MON 18:00 TO 19:00

Passion for Extreme Light

Gerard Mourou, École Polytechnique (France)

2018 Physics Nobel Prize Laureate

For details, please see page 6.
TUESDAY 25 JUNE

SESSION 3

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

3D and Shape Metrology

Session Chair: Bryan M. Barnes, National Institute of Standards and Technology (USA)

8:30: Model based laser focus scanning: the path towards improved lateral resolution (Invited Paper), Jörg Bischoff, Osiris Optical Engineering (Germany); Dara Salido-Monzú, Frank Scholze, Physikalisch-Technische Bundesanstalt (Germany). ...................................... [11057-11]

9:00: Characterization of the topography fidelity of 3D optical microscopy, Sven Burger, Physikalisch-Technische Bundesanstalt (Germany). ........................... [11057-12]

9:20: Simulation of 3D laser scanning with phase-based EDM for the prediction of systematic deviations, David Salido-Monzú, Andreas Wieser, ETH Zurich (Switzerland). .................. [11057-13]


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

SESSION 4

LOCATION: ICM, 12B  ................. TUE 10:30 TO 12:30

Scatterometry

Session Chair: Jörg Bischoff, Osiris Optical Engineering (Germany)

10:30: Efficient global sensitivity analysis for silicon line gratings using polynomial chaos (Invited Paper), Nando Farchmin, Sebastian Heidenreich, Markus Bär, Physikalisch-Technische Bundesanstalt (Germany); Martin Hammerschmidt, Philipp-Immanuel Schneider, JCMwave GmbH (Germany); and Zuse Institute Berlin (Germany). ........................................ [11057-15]

11:00: Supplementing rigorous electromagnetic modeling with atomistic simulations for optics-based metrology (Invited Paper), Bryan M. Barnes, Hui Zhou, Richard M. Silver, Mark-Alexander Henn, National Institute of Standards and Technology (USA). ....................................................... [11057-16]

11:30: Benchmarking global optimization and machine learning methods for parameter reconstruction, Philipp-Immanuel Schneider, Martin Hammerschmidt, Lin Zschiephard, Sven Burger, JCMwave GmbH (Germany). ....................................................... [11057-17]

11:50: Reference-free GIXRF of nanostructures for element sensitive profile reconstruction, Anna Andrle, Victor Softwaich, Philipp Hönice, Yves Kayser, Burkhard Beckhoff, Physikalisch-Technische Bundesanstalt (Germany); Philipp-Immanuel Schneider, Martin Hammerschmidt, JCMwave GmbH (Germany); Sven Burger, Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany) and JCMwave GmbH (Germany); Frank Scholze, Physikalisch-Technische Bundesanstalt (Germany). ....................................................... [11057-18]


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

SESSION 5

LOCATION: ICM, 12B  ................. TUE 13:30 TO 15:40

Mueller Matrix, Ellipsometry and Polarimetry

Session Chair: Alois Herkommer, Institut für Technische Optik (Germany)


14:00: Polarization metrology for high numerical aperture DUV objectives, Robert D. Grejda, Paul F. Michaloski, Duncan C. Spaulding, Stephen K. Mack, Robert L. Michaels, Paul G. Deua, David L. Aronstein, Coming Tropel Corp. (USA). ....................................................... [11057-21]

14:20: Vectorial modeling for the image formation of a high-numerical-aperture Mueller-matrix ellipsometer, Cai Wang, Chao Chen, Xiuguo Chen, Shiyuan Liu, Huazhong Univ. of Science and Technology (China). . . . [11057-22]

14:40: Mueller matrix ellipsometry for enhanced optical form metrology of sub-lambda structures, Tim Käseberg, Johannes Dickmann, Physikalisch-Technische Bundesanstalt (Germany); Thomas Siefke, Friedrich-Schiller-Univ. Jena (Germany) and Physikalisch-Technische Bundesanstalt (Germany); Matthias Wurm, Physikalisch-Technische Bundesanstalt (Germany); Stefanie Kroeker, Technische Univ. Braunschweig (Germany) and Physikalisch-Technische Bundesanstalt (Germany); Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany). ........................ [11057-23]

15:00: An improved method to derive best-fit parameters and their uncertainties from depolarizing Mueller-matrices, Tobias Grunewald, Physikalisch-Technische Bundesanstalt (Germany); Matthias Wurm, Sven Teichert, Bernd Bodermann, Physikalisch-Technische Bundesanstalt (Germany); Johanna Reck, Uwe Richter, Sentechn Instruments GmbH (Germany). ....................................................... [11057-24]

15:20: Fast compressed channeled spectropolarimeter for full Stokes vector measurement, Guodong Zhou, Yanqiu Li, Jianhui Li, Jiazi Wang, Beijing Institute of Technology (China). . . . . . . . . . [11057-25]

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

SESSION 6

LOCATION: ICM, 12B  ................. TUE 16:10 TO 17:30

Interferometry II

Session Chair: Giancarlo Pedrini, Institut für Technische Optik (Germany)

16:10: An improved control structure for the tracking of sine command in a motion simulator, Bernard Vau, IXBlue SAS (France); Damien Poncet, IXBlue Motion Systems (France); Mehdi Bussuti, IXBlue SAS (France). ....................................................... [11057-26]

16:30: Physical optics modeling of interferometer-based metrology systems, Site Zhang, LightTrans International UG (Germany); Huiying Zhong, Rui Shi, Friedrich-Schiller-Univ. Jena (Germany); Christian Hellmann, Wyrowski Photonics UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany). ....................................................... [11057-27]

16:50: Extending wavefront sensing range of phase diversity, Zhao-jun Yan, Shanghai Astronomical Observatory (China); Penggai Yang, Shanghai Institute of Optics and Fine Mechanics (China). . . . . . . . . . . . [11057-28]

17:10: Faster region-based convolutional neural network method for estimating parameters from Newton’s rings, Chenchen Ji, Xiangfeng Lu, Jinmin Wu, Zhen Guo, Feng Zhang, Ran Tao, Beijing Institute of Technology (China). . . . . . . . . . . [11057-30]
Towards a complete framework for calibration of optical surface and coordinate measuring instruments

Richard Leach, Univ. of Nottingham (United Kingdom)

For details, please see page 7.

A method for improving the accuracy of an extinction coefficient measurement of weakly absorbing interference layers, Van Ba Nguyen, Lyudmila Aleksandrovna Gubanova, Saint-Petersburg State Univ. (Russian Federation) ........................................... [11057-56]

Evaluation of the aberrations of a PDMS lens, Manuel Campos-Garcia, Univ. Nacional Autónoma de México (Mexico); Ángel Eugenio Martínez-Rodríguez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Oliver Huerta-Carranza, Celestino Vargas-Allred, Univ. Nacional Autónoma de México (Mexico); Agustín Santiago-Alvarado, Univ. Tecnológica de la Mixteca (Mexico); Víctor Iván Moreno-Oliva, Univ. del Istmo (Mexico) ........................................... [11057-57]

Modelling and tolerance analysis of volume-phase gratings in complex dispersive units, Andrey Melnikov, OJSC "Scientific and Production Association State Institute of Applied Optics" (Russian Federation); Maxim Bakshaev, Kazan National Research Technical Univ. A.N. Tupoleva - KAI (Russian Federation); Eduard R. Muslimov, Lab. d’Astrophysique de Marseille (France) and Kazan National Research Technical Univ. A.N. Tupoleva - KAI (Russian Federation); Ilya Gusakov, Kazan National Research Technical Univ. A.N. Tupoleva - KAI (Russian Federation) ........................................... [11057-58]

A fully coupled diffusion-mechanical formulation for growth kinetics of precipitates in laser powder bed fusion process using a phase field approach, Fikret K. Mirzade, Institute of Laser and Information Technologies of the RAS (Russian Federation) ........................................... [11057-59]

On modeling of heat transfer and molten pool behavior in multilayer and multitrack laser additive manufacturing processes, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Univ. of Stuttgart (Germany) ........................................... [11057-60]

A flexible and simplified calibration procedure for fringe projection profilers, Raúl Vargas, Jesús Ernesto Núñez, Levent Romero, Univ. Tecnológica de Bolívar (Colombia) ........................................... [11057-61]

Measurement of errors by axial misalignment and tilt of the null screen used in experimental arrangements by deflectometry, Diana Nallely Castán-Ríos, Fermín S. Granados-Agustín, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Francisco Mejía-Poloño, Gatera, Vega-Rios-Gonzalez, Univ. de Investigación y Desarrollo (Colombia); María Elizabeth Percino-Zacarías, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Maximino Avenaño-Alejo, Univ. Nacional Autónoma de México (Mexico); Alejandro Cornejo-Rodríguez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) ........................................... [11057-62]

Design of a two-mirror telescope using a freeform surface for the primary mirror, Jorge de Jesús Alvarado-Martínez, F. Granados Agustín, Sergio Vázquez y Montiel, María Elizabeth Percino-Zacarías, Alejandro Cornejo-Rodríguez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) ........................................... [11057-63]

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

Photometry and Radiometry

Session Chair: Wolfgang Osten, Univ. Stuttgart (Germany)

Please note the room change

13:40: Hyperspectral imager calibration using ceramic color tiles (Invited Paper), Matti A. Eskelinen, Univ. of Jyväskylä (Finland); Clarence J. Zarobila, National Institute of Standards and Technology (USA) ........................................... [11057-31]

14:10: Performance enhancement of a BRDF test bench using an algorithm feed with laser-tracker measurements, Lionel Clermont, Céline Michel, Emmanuel Mazy, Ctr. Spatial de Lière (Belgium) ........................................... [11057-32]

14:30: Simulation of computational ghost imaging: application for 3D measurement, Christopher Freitag, Peter Kötzler, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Gunther Notri, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Ilmenau University of Technology (Germany); Herbert Gross, Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena (Germany) ........................................... [11057-33]

14:50: Anomaly detection method of satellites working status based on photometric data, Can Xu, Peng Li, Xia Wang, Space Engineering Univ. (China) ........................................... [11057-34]

15:10: Wavefront and focal spot control of the SG II peillage laser facility, Pengda Yang, Shanghai Institute of Optics and Fine Mechanics (China); Zhaoyun Yan, Shanghai Astronomical Observatory (China); Yong Cui, Quantang Fan, Zhiucai Jiang, Liangjun Zhang, Guang Xu, Jian Zhu, Jianqiang Zhu, Shanghai Institute of Optics and Fine Mechanics (China) ........................................... [11057-35]

Coffee Break ........................................... Wed 15:30 to 16:00
SESSION 8
LOCATION: ICM, 12A ................. WED 16:00 TO 18:00
Optical Systems
Session Chair: Karsten Frenner, Institut für Technische Optik (Germany)

Please note the room change

16:00: Modelling of coherence scanning interferometry for complex surfaces based on a boundary element method, Matthew Thomas, Rong Su, The Univ. of Nottingham (United Kingdom); Nikolay Nikolaev, Jeremy M. Coupland, Loughborough Univ. (United Kingdom); Richard Leach, The Univ. of Nottingham (United Kingdom). ................................... [11057-36]

16:20: Optical time domain reflectometer for precision measurement of signal delay in optical fiber, Sergey S. Donchenko, Oleg Kholmogorov, Dmitriy Prokhorov,Ekaterina Chemesova, VNIIFTRI (Russian Federation). ...................................[11057-37]

16:40: ELT-HIRES the high-resolution spectrograph for the ELT: simulation results of polarimetric aberrations for the polarimetric module, Igor Di Varano, Manfred Woche, Michael Weber, Klaus G. Strassmeier, Leibniz-Institut für Astrophysik Potsdam (Germany); Shu Yuan, Yunnan Astronomical Observatories (China) ...........................................[11057-38]

17:00: Estimation of reflectance factors and their uncertainties from multiple measurements, Matti A. Eskelinen, Univ. of Jyväskylä (Finland); John Lu, National Institute of Standards and Technology (USA). .......[11057-39]

17:20: Superaccurate camera calibration via inverse rendering, Morten Hannemose, Technical Univ. of Denmark (Denmark); Jakob Wilm, University of Southern Denmark (Denmark) and University of Southern Denmark (Denmark); Jeppe Revall Frisvad, Technical Univ. of Denmark (Denmark). .......[11057-40]

17:40 Transmission telescope optical metrology, Viviana Vladutescu, New York City College of Technology (USA); Aaron J. Swank, Dzu K. Le, Calvin R. Robinson, Félix A. Miranda, NASA Glenn Research Ctr. (USA); Victor Pena, Baruch College (USA); Katherine Chun, Univ. of Washington (USA) .[11057-63]

LOCATION: ICM, 12A ....................... 18:00 TO 18:10
Closing Remarks

Optics for Arts, Architecture, and Archaeology VII

Conference Chairs: Haida Liang, Nottingham Trent Univ. (United Kingdom); Roger Groves, Technische Univ. Delft (Netherlands)
Conference Co-Chair: Piotr Targowski, Nicolaus Copernicus Univ. (Poland)

Programme Committee: Dario Ambrosini, Univ. degli Studi dell’Aquila (Italy); Marta Castillejo, Consejo Superior de Investigaciones Científicas (Spain); Daniela Cornelli, Politecnico di Milano (Italy); Claudia Daffara, Univ. degli Studi Verona (Italy); Vincent Detalle, Centre de Recherche et de Restauration des Musées de France (C2RMF) (France); John K. Delaney, National Gallery of Art (USA); Martin C. Fischer, Duke Univ. (USA); Raffaella E. M. Fontana, Istituto Nazionale di Ottica (Italy); Igor P. Gurov, ITMO Univ. (Russian Federation); Alexander J. Kossolapov, State Hermitage Museum (Russian Federation); Gaël Latour, Univ. Paris-Sud (France); Nicola Masini, Consiglio Nazionale delle Ricerche (Italy); Luca Pezzati, Istituto Nazionale di Ottica-CNR (Italy); David R. Saunders, International Institute for Conservation (United Kingdom); Robert Sitnik, Warsaw Univ. of Technology (Poland); Vivi Tornari, Foundation for Research and Technology-Hellas (Greece)

MONDAY 24 JUNE

SESSION 1

LOCATION: ICM, 12A ................. MON 8:30 TO 10:00

3D Tomography: Applications

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

8:30: Nondestructive observation of multilayered modern paintings by electromagnetic waves (Invited Paper), Kueishi Bai, Ctr. de Recherche et de Restauration des Musées de France (France) and Ctr. de Recherche sur la Conservation (France); Chi Shing Cheung, Haida Liang, Nottingham Trent Univ. (United Kingdom) and The British Museum (United Kingdom); Chikako Enoki, Musées de France de Paris-Saclay (France) and Musée des Arts décoratifs (France); Corinna Koch-Dandolo, Ctr. de Recherche et de Restauration des Musées de France (France) and Fondation des Sciences du Patrimoine (France); Stéphane Serfaty, Nicolas Wilkie-Chancellier, Univ. de Cergy-Pontoise (France); Vincent Detalle, Ctr. de Recherche et de Restauration des Musées de France (France) (Invited Paper).

9:40: A noninvasive investigation of Limoges enamels using both optical coherence tomography (OCT) and spectral imaging, Margaret Read, Nottingham Trent Univ. (United Kingdom) and The British Museum (United Kingdom); Chi Shing Cheung, Haida Liang, Nottingham Trent Univ. (United Kingdom); Denise Ling, Capucine Korenberg, The British Museum (United Kingdom) (Invited Paper) (Session Chair: Richard Newstead, Univ. of Reading, UK).

9:20: NiYAG vs ErYAG: a comparative study of laser vegan removal on easel paintings, Maxime Lopez, Ctr. de Recherche et de Restauration des Musées de France (France); Kueishi Bai, Ctr. de Recherche et de Restauration des Musées de France (France) and Ctr. de Recherche sur la Conservation (France); Corinna Koch-Dandolo, Ctr. de Recherche et de Restauration des Musées de France (France) and Fondation des Sciences du Patrimoine (France); Chikako Enoki, Musées de France de Paris-Saclay (France) and Musée des Arts décoratifs (France); Corinna Koch-Dandolo, Ctr. de Recherche et de Restauration des Musées de France (France) (Invited Paper) (Session Chair: Richard Newstead, Univ. of Reading, UK).

LOCATION: ICM, 12A ................. MON 11:20 TO 13:10

Light-Matter Interaction and Nonlinear Optics

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

11:20: The study of the degradation of cadmium yellow paints through their photoluminescence emission from trap states (Invited Paper), Daniela Cornelli, Marta Ghirardello, Gianluca Valentini, Politecnico di Milano (Italy); Austin Nevin, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Douglas MacLennan, Alan Phenix, Catherine Schmidt Patterson, Herant Khanjian, Karen Trentelman, The Getty Conservation Institute (USA); Lucio Toniolo, Politecnico di Milano (Italy); Aviva Buzin, Courtauld Institute of Art (United Kingdom); Markus Gross, Fondation Beyeler (Switzerland) (Invited Paper).

12:10: Determination of thresholds for safe analyses of acrylic paintings by nonlinear optical microscopy, Mixel Sanz, Mohamed Ouja, Consejo Superior de Investigaciones Científicas (Spain); Raffaella E. M. Fontana, Riccardo Cicchi, Alice Dal Fovo, Sara Mattana, Consiglio Nazionale delle Ricerche, Istituto Nazionale di Ottica (Italy); Marco Marchetti, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy); Marta Castillejo, Consejo Superior de Investigaciones Científicas (Spain) (Session Chair: John K. Delaney, National Gallery of Art (USA)).

12:30: The potential of nonlinear optical microscopy to noninvasively quantify the degradation state of historical parchments, Margaux Schmeltz, Lab. d’Optique et Biosciences (France); Laurianne Robinet, Ctr. de Recherche sur la Conservation (France) and Musée national d’Histoire naturelle, Ctr. de Recherche sur la Conservation (France); Claire Teulon, Guillaume Ducournial, Marie-Claire Schanne-Klein, Lab. d’Optique et Biosciences (France); Gaël Latour, Imagerie et Modélisation en Neurobiologie et Cancérologie (France) and Univ. Paris-Sud (France) and Univ. Paris-Saclay (France).

12:50: A study on the coloring mechanism of famous ancient Chinese ceramics, Weidong Li, Shanghai Institute of Ceramics (China) (Session Chair: John K. Delaney, National Gallery of Art (USA)).

Lunch Break

SESSION 2

LOCATION: ICM, 12A ................. MON 14:10 TO 15:50

Imaging and Spectroscopy for Material Analysis

Session Chair: Martin C. Fischer, Duke Univ. (USA)

14:10: A hyperspectral camera for conservation science, based on a birefringent ultrastable common path interferometer, Cristian Manzoni, CNR-INFPA (Italy) and Politecnico di Milano (Italy); Antonio Perri, Politecnico di Milano (Italy); Bábara E. Nogueira de Faria, Daniela C. Teles Ferreira, Univ. Federal de Minas Gerais (Brazil); Dario Polli, Daniela Cornelli, Gianluca Valentini, Giulio N. Cerullo, Politecnico di Milano (Italy) (Invited Paper).

14:30: Maximizing the microscope: instrument design and data processing strategies for hyperspectral imaging of cross-sectional cultural heritage samples, Lindsay Oakley, Marc S. Walton, Northwestern Univ. (USA).
TUESDAY 25 JUNE

SESSION 5

LOCATION: ICM, 12A  TUE 8:10 TO 10:00

Optical Coherence Tomography: Instruments and Methods

Session Chair: Gaël Latour, Univ. Paris-Sud (France)

8:10: Multiscale optical coherence tomography imaging of “The girl with a pearl earring” (Invited Paper), Jeroen Kalkman, Joris Dik, Tom Callewaert, Technische Univ. Delft (Netherlands) ........................................... [11058-20]

8:40: High-penetrance high-resolution time domain optical coherence tomography for cultural heritage applications, Bing Xu, Kuan He, Fengxiao Hao, Jian Gao, Florian Willmitzer, Aggelos K. Katsaggelos, John E. Thumblin, Oliver Cossairt, Marc S. Walton, Northwestern Univ. (USA) [11058-21]

9:00: Multimodal mid-infrared optical coherence tomography for art diagnosis, Ivan Zorin, RECENDT (Australia) ............................... [11058-22]

9:20: Simultaneous measurement of refractive index and dispersion using optical coherence tomography for the conservation of plastic sculptures, Mixon Falusweki, Haida Liang, Chi Shing Cheung, Nottingham Trent Univ. (United Kingdom) ......................... [11058-23]

9:40: Noninvasive depth-resolved material characterisation using OCT and spectral imaging, Patrick S. Atkinson, Chi Shing Cheung, Haida Liang, Nottingham Trent Univ. (United Kingdom); Catherine Higgit, Marika Spring, The National Gallery (United Kingdom) ........................................ [11058-24]

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

SESSION 6

LOCATION: ICM, 12A  TUE 10:30 TO 11:30

Advanced Image Processing

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

10:30: A novel methodology for the automatic analysis of large collections of paintings, Sofiota Kogou, Nottingham Trent Univ. (United Kingdom); Lynn Lee, The Getty Conservation Institute (USA); Golnaz Shahtahmassebi, Haida Liang, Nottingham Trent Univ. (United Kingdom) ......................... [11058-25]

10:50: MD-FTRIR macro mapping and clustering-based automatic brushing: an advanced diagnostic tool for in situ investigations of artworks, Emilio Catelli, Giorgia Scutto, Silvia Prati, Univ. degli Studi di Bologna (Italy); Paolo Oliveri, Univ. degli Studi di Genova (Italy); Stijn Legrand, Koen Janssens, Univ. Antwerpen (Belgium); Rocco Mazzeo, Univ. degli Studi di Bologna (Italy) .................................................. [11058-26]

11:10: Unbending light: new computational methods for the correction of 3D effects in scanning KRF, Monica Gario, The Getty Conservation Institute (USA); Stephen Parsons, Seth Parker, Univ. of Kentucky (USA); Marie Svoboda, J. Paul Getty Museum (USA); Brent Seales, Univ. of Kentucky (USA); Catherine Schmidt Patterson, The Getty Conservation Institute (USA) ......................... [11058-27]

Coffee Break ................................. Tue 10:30 to 11:00

SESSION 7

LOCATION: ICM, 12A  TUE 11:30 TO 12:30

Poster Pitch Presentations

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

Three-minute oral presentations (poster pitch presentations) will take place in the conference room. Each brief poster overview will consist of three-minute talk including no more than three slides (powerpoint presentation) as part of this presentation. Poster Pitch Session will be followed by the official conference Poster Session 12:30 to 13:10 hrs in the designated area in Hall B1 with all posters on display and authors present at their posters.

The metallography and corrosion of an ancient Chinese bimetallic bronze sword ................................. [11058-45]

Analytical characterization of gold leaves of forth (innermost) shrine of the King Tut Ankh Amun ......................... [11058-46]

Fluorescence lifetime imaging a good approach to revealed gilded and polychromed surface under black encrustation of marble object? [11058-47]

Follow up of restoration of works of art of the patrimony by infrared thermography ......................... [11058-49]
High-resolution visible and infrared imaging for large paintings: a case study of Israel in Egypt by Poynter ............................................................... [11058-50]
Tattoo Wall®: study of the stability of an innovative decorative technique through hyperspectral imaging and possible application in the mural paintings’ restoration ................................................................. [11058-51]
In-situ nondestructive detection and analysis of the structure of clay statue cultural heritage ................................................................. [11058-52]
Early detection of biofilm development on stone monuments thanks to pulsed IR and SVD ........................................................................ [11058-53]
Evaluation methods of effect of cleaning techniques on library collagen materials. Magda Součková, Jitka Neoralová, Petra Vávrová, The National Library of the Czech Republic (Czech Republic); Ludmila Mašková, Jiří Smolík, Institute of Chemical Process Fundamentals of the CAS, v.v.i. (Czech Republic) .................................................................................. [11058-54]
Method for the analysis of spectral imaging data from Tang Tomb murals. Qunxi Zhang, Shaanxi History Museum (China); Jun Wang, Zhenrong Sun, Yongqin Zhang, Jinye Peng, Northwest Univ. (China); Haiida Liang, Nottingham Trent Univ. (United Kingdom) .................................................................................. [11058-55]
Smartphone diagnostics for cultural heritage. Claudia Daffara, Univ. degli Studi di Verona (Italy) and Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caiñiello”, Consiglio Nazionale delle Ricerche (Italy); Giacomo Marchion, Univ. degli Studi di Verona (Italy); Dario Ambrosini, Univ. degli Studi dell’Aquila (Italy) and Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caiñiello”, Consiglio Nazionale delle Ricerche (Italy) .......................................................... [11058-56]
Scanning the Celts: evaluation of 2D and 3D techniques in protohistoric archaeology, Charlotte Hochart, Elsa Lambert, Ctr. de Recherche et de Restauration des Musées de France (France) .................................................................................. [11058-57]
Non-artistic materials in artistic works by David Lynch: multidisciplinary approach, Miroslav Wachowiak, Grazyna Szczepańska, Klaudia Gontowski, Nicolaus Copernicus Univ. (Poland) .................................................................................. [11058-58]
Comprehensive study of the fresco of Raphael’s workshop “Venus tying a sandal” from the State Hermitage Museum’s collection. ........................................ [11058-60]
Non-artistic materials in artistic works by David Lynch: multidisciplinary approach, Ksenia Chugunova, Sergey Khavrin, Polina Kondrakhina, Ludmila Gavrilenko, Antonella Veneri, Univ. degli Studi della Tuscia (Italy); Silvia Serranti, Sapienza, Giorgia Agresti, Univ. degli Studi della Tuscia (Italy); Claudia Pelosi, Univ. degli Studi della Tuscia (Italy); Cristina Cabello-Briones, Univ. Autónoma de Madrid (Spain); Santiago Mayorga-Pinilla, Univ. Complutense de Madrid (Spain); Joaquín Barrio-Cabello, Ctr. de Investigación de Patrimonio Cultural Heritage (Spain) .................................................................................. [11058-61]
Incrustation of ancient Saka scabbard: material studies by Raman and FTIR spectroscopy ........................................................................ [11058-62]
Development of a drone-based spectral imaging system for archaeological applications ........................................................................ [11058-63]
Poster Session 1 on Tuesday. Come view the posters and network with conference attendees. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 12:30 through 13:10 hrs on Tuesday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/x6513.xml . (Follow the Special Events link)

Poster Session Chair: Stéphanie Eyssautier, Karim Mohouibi, Fany Reffoulou, Jean Luc Bodnar, Univ. de Reims Champagne-Ardenne (France) .... [11058-59]

LOCATION: ICM, HALL B0 ............... TUE 12:30 TO 13:10

High-resolution visible and infrared imaging for large paintings: a case study of Israel in Egypt by Poynter ............................................................... [11058-50]
Tattoo Wall®: study of the stability of an innovative decorative technique through hyperspectral imaging and possible application in the mural paintings’ restoration, Giorgia Agresti, Univ. degli Studi della Tuscia (Italy); Giuseppe Bonfazi, Giuseppe Capobianco, Sapienza Univ. di Roma (Italy); Claudia Pelosi, Univ. degli Studi della Tuscia (Italy); Silvia Serranti, Sapienza Univ. di Roma (Italy); Antonella Veneri, Univ. degli Studi della Tuscia (Italy) .................................................................................. [11058-51]
In-situ nondestructive detection and analysis of the structure of clay statue cultural heritage, Ke Bai, Shanxi Institute for the Preservation of Cultural Heritage (China) .................................................................................. [11058-52]
Stimulated IRT for detection of bacterial biofilm on building limestones. Stéphanie Eyssautier, Karim Mohouibi, Fany Reffoulou, Jean Luc Bodnar, Univ. de Reims Champagne-Ardenne (France) .................................................................................. [11058-53]

SESSION 8

LOCATION: ICM, 12A ............... TUE 14:20 TO 15:30

Remote Imaging and Spectroscopy

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

14:30: Long-range remote spectroscopy for wall paintings and architectural interiors. Yu Li, Chi Shing Cheung, Sotiria Kogou, Alex Hogg, Florence Liggins, Luke Butler, Haiida Liang, Nottingham Trent Univ. (United Kingdom) .................................................................................. [11058-59]
Coffee Break ................................. TUE 15:30 TO 16:00
Applications to Cultural Heritage

Session Chair: Daniela Comelli, Politecnico di Milano (Italy)

16:00: Optical coherence tomography of 19th century glass: facts and phantoms (Invited Paper), Lynn Bloorstof, Carol Lynn Ward Bamford, Library of Congress (USA); Tara Diba, Murray H. Loew, Jason M. Zara, The George Washington Univ. (USA) ............................ [11058-31]

16:30: Novel imaging spectroscopy applications for the study of ancient and Byzantine Cypriot monumental paintings, Roxanne Rapoud, Univ. of California, Los Angeles (USA); John K. Delaney, National Gallery of Art (USA); Ioanna Kakkouli, Univ. of California, Los Angeles (USA) ............. [11058-32]

16:50: Analysis of the physical characteristics and chemical composition of gold leaf in works of art by scanning macro X-ray fluorescence (MA-XRF) spectroscopy, Douglas MacLennan, The Getty Conservation Institute (USA); Arlen Heginbotham, J. Paul Getty Museum (USA); Monica Ganio, The Getty Conservation Institute (USA); John K. Delaney, National Gallery of Art (USA); Lynn Lee, The Getty Conservation Institute (USA); Laura Llewellyn, J. Paul Getty Museum (USA); Karen Trentelman, The Getty Conservation Institute (USA) ............................ [11058-33]

17:10: Physicochemical monitoring of conservation state of the 19th century glass beads, Dmitri V. Pankin, Saint Petersburg State Univ. (Russian Federation); Irina F. Kadikova, GosNIIIR (Russian Federation); Ekaterina A. Morozova, GosNIIIR (Russian Federation) and Kurnakov Institute of General and Inorganic Chemistry of the RAS (Russian Federation); Tatiana V. Yuryeva, GosNIIIR (Russian Federation); Irina A. Grigorieva, The State Hermitage Museum (Russian Federation); Ilya B. Analashev, The Russian Federal Ctr. of Forensic Science of the Ministry of Justice (Russian Federation); Maria V. Lukasheva, TESCAN Ltd. (CIS) (Russian Federation); Anastasia Povolotskaia, Saint Petersburg State Univ. (Russian Federation); Vladimir A. Yuryev, A.M. Prokhorov General Physics Institute of the RAS (Russian Federation) [11058-34]

17:30: Multianalytical investigation of the ancient nomads polychromic belt buckles, Nikolai S. Kurganov, Saint Petersburg State Univ. (Russian Federation); Sergey Khavrin, The State Hermitage Museum (Russian Federation); Dmitrii V. Pankin, Saint Petersburg State Univ. (Russian Federation); Irina A. Grigorieva, Ksenia Chugunova, The State Hermitage Museum (Russian Federation); Marina Kilinovskaya, Institute for the History of Material Culture (Russian Federation); Anastasia Povolotskaia, Alexey Kurochkin, Saint Petersburg State Univ. (Russian Federation) ............................ [11058-35]

MULTIANALYTICAL INVESTIGATION OF THE ANCIENT NOMADS POLYCHROMIC BELT BUCKLES, Nikolai S. Kurganov, Saint Petersburg State Univ. (Russian Federation); Sergey Khavrin, The State Hermitage Museum (Russian Federation); Dmitrii V. Pankin, Saint Petersburg State Univ. (Russian Federation); Irina A. Grigorieva, Ksenia Chugunova, The State Hermitage Museum (Russian Federation); Marina Kilinovskaya, Institute for the History of Material Culture (Russian Federation); Anastasia Povolotskaia, Alexey Kurochkin, Saint Petersburg State Univ. (Russian Federation)

Session Chair: Daniela Comelli, Politecnico di Milano (Italy)

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Multimodal Sensing and Artificial Intelligence: Technologies and Applications

Conference Chair: Ettore Stella, CNR (Italy)
Conference Co-Chairs: Shahriar Negahdaripour, Univ. of Miami (USA); Dariusz Ceglarek, The Univ. of Warwick (United Kingdom); Christian Möller, Fraunhofer-Institut für Fertigungsstechnik und Angewandte Materialforschung (Germany)
Programme Committee: Andrei G. Anisimov, Technische Univ. Delft (Netherlands); Salah Bourennane, Institut Fresnel (France); Cosimo Distanti, Univ. del Salento (Italy); Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Marc P. Georges, Liège Univ. (Belgium); Antonio Lanzotti, Univ. degli Studi di Napoli Federico II (Italy); Luiz Marcos Garcia Gonçalves, UFRN (Brazil); Michele Meo, Univ. of Bath (United Kingdom); Thomas B. Moeslund, Aalborg Univ. (Denmark); Nicola Mosca, CNR (Italy); Vito Pagliarulo, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Clive Roberts, The Univ. of Birmingham (United Kingdom); Pierre R. Slangen, Mines Alès (France); Rocco Zito, Flinders Univ. (Australia)

WEDNESDAY 26 JUNE
SESSION 1

LOCATION: ICM, 12B  .................. WED 8:10 TO 10:00

Multimodal Sensing for Surveillance

Session Chair: Francesco Soldovieri, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Massimiliano Nolich, Univ. degli Studi di Trieste (Italy)

8:10: Multimodal surveillance systems for the continuous monitoring of heterogeneous environments and danger prevention, Massimiliano Nolich, Univ. degli Studi di Trieste (Italy); Francesco Soldovieri, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Massimiliano Nitti, Antonio Petitti, Vito Renò, Istituto di Sistemi e Tecnologie Industriali Intelligenti per il Manufatturiero Avanzato (Italy); Ilaria Catapano, Gianluca Gennarelli, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Raol Buqi, Univ. degli Studi di Trieste (Italy) ............................... [11059-1]

8:30: Radar for indoor surveillance: state of art and perspectives (Invited Paper), Francesco Soldovieri, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Moeness Amin, Villanova Univ. (USA) ............................... [11059-2]

9:00: Microwave imaging through an unknown wall by a MIMO configuration and SVD approach, Raffaele Solimene, Tushar Rajvanshi, Giovanni Buonanno, Angelo dell’Aversano, Univ. degli Studi della Campania Luigi Vanvitelli (Italy) ............................... [11059-3]

9:20: Radiometer effectiveness in real cases for disclosing stealth, Hao Liu, Harbin Institute of Technology (China); Chao Wu, Harbin Institute of Technology (China); Dajing Wang, Hongmei Li, Jinghui Qiu, Alexander G. Denisov, Harbin Institute of Technology (China) ............................... [11059-4]

9:40: Passive radar for measuring passive sensors: direct signal interference suppression on FPGA using orthogonal matching pursuit and stochastic gradient descent, Jean-Michel Friedt, Institut Franche-Comté Electronique Mecanique Thermique et Optique (France); Weike Feng, Tohoku Univ. (Japan); Stephane Chretien, National Physical Lab. (United Kingdom); Gwenhael Goavec, Institut Franche-Comté Electronique Mecanique Thermique et Optique (France); Motoyuki Sato, Tohoku Univ. (Japan) ............................... [11059-5]

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

SPIE OPTICAL METROLOGY PLENARY SESSION

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

Towards a complete framework for calibration of optical surface and coordinate measuring instruments

Richard Leach, Univ. of Nottingham (United Kingdom)

For details, please see page 7.

POSTERS-WEDNESDAY

LOCATION: ICM, HALL B00  .................. 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 6, and at http://spie.org/x6513.xml. (Follow the Special Events link on the left side of the page.)

Multibiometric systems in hospitality: methodologies and use cases in hotel scenarios, Massimiliano Nolich, Sara Carciotti, Raol Buqi, Walter Ukovich, Univ. degli Studi di Trieste (Italy); Francesco Soldovieri, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy) ............................... [11059-38]

Study of the 360° light field display, Chong Zeng, Zhihong Zeng, Huaalong Guo, Longyan Univ. (China) ............................... [11059-37]

Power law scaling of test error versus number of training images for deep convolutional neural networks, Vittorio Sala, IMAGE S s.p.a. (Italy) [11059-39]

Robot welding seam tracking system research based on image identification, Hongwei Sun, Peng Xu, Yu Han, Chao Liu, Jiangsu Automation Research Institute (China) ............................... [11059-40]

Research of spatial alignment techniques for multimodal image fusion, Aytomy Akhtnerov, Alexandr S. Vasilev, Anna V Vasileva, ITMO Univ. (Russian Federation) ............................... [11059-41]

Predictive models for abundance estimation and distribution maps of the striped dolphin Stenella coeruleoalba and the bottlenose dolphin Tursiops truncatus in the Northern Ionian Sea (North-eastern Central Mediterranean), Vito Renò, Consiglio Nazionale delle Ricerche (Italy); Carmelo Fanizza, Ionian Dolphin Conservation (Italy); Giovanni Dimauro, Univ. degli Studi di Bari Aldo Moro (Italy); Vito Tellesca, Univ. degli Studi della Basilicata (Italy); Pierluigi Dibari, Gennaro Gala, Univ. degli Studi di Bari Aldo Moro (Italy); Nicola Mosca, Consiglio Nazionale delle Ricerche (Italy); Giulia Cipriano, Roberto Carlucci, Univ. degli Studi di Bari Aldo Moro (Italy); Rosalisa Maglietta, Consiglio Nazionale delle Ricerche (Italy) ............................... [11059-42]

An electro-optical system for transverse displacement measurement with rotation parameters estimation of the measurement unit, Anh Phuong Hoang, Alexey Gorbachev, ITMO Univ. (Russian Federation) ............................... [11059-43]

A rapid nanotexturing of microneedle patch procedure for multimodal sensing and fabricating polymeric 3D arrays with biomaterials using hydrophobic elastomeric molds, Sungwon Hwang, Sangmyung Univ. (Korea, Republic of) ............................... [11059-44]

Floor integrated optical fall detector for frail people, Ronny Masche, Westsächsische Hochschule Zwickau (Germany); Christopher Taudt, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer Institut für Werkstoff- und Strahltechnik IWS, Anwendungszentrum für Optische Messtechnik (Germany); Florian Rudak, Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer Institut für Werkstoff- und Strahltechnik IWS, Anwendungszentrum für Optische Messtechnik (Germany) ............................... [11059-45]

Lunch Break  .................. Wed 12:30 to 13:40
THURSDAY 27 JUNE

LOCATION: ICM, 12B ............................. THU 8:10 TO 10:00

Multimodal Sensing for Infrastructure Monitoring

Session Chairs: Ilaria Catapano, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Shahin Negahdarpour, Univ. of Miami (USA)

8:10: UAV radar imaging for target detection (Invited Paper), Ilaria Catapano, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Giancarmine Fasano, Alfredo Renga, Univ. degli Studi di Napoli Federico II (Italy); Giovanni Ludiero, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy) ................................................................. [11059-14]

8:40: Imaging capabilities of an airborne X-band SAR based on the FMCW technology, Antonio Natale, Carmen Esposito, Paolo Berardino, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Gianfranco Palmese, Elettra Microwave S.r.l. (Italy); Riccardo Lanari, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Stefano Perna, Univ. degli Studi di Napoli Parthenope (Italy) ................................................................. [11059-15]

9:00: Study of complementary multisensor data influence on infrared thermography measurements for in situ long-term monitoring, Thibaud Toullier, Institut National de Recherche en Informatique et en Automatique (France) and Institut Francais des Sciences and Technologies des Transports de l’amenagement et des Reseaux (France); Jean Dumoulin, Institut Francais des Sciences et Technologies des Transports de l’amenagement et des Reseaux (France) and Institut National de Recherche en Informatique et en Automatique (France); Laurent Mevel, Institut de Recherche en Informatique et Systèmes Alytories (France) and Institut Francais des Sciences et Technologies des Transports de l’amenagement et des Reseaux (France) ................................................................. [11059-16]

9:20: Automatic network level bridge monitoring by integration of InSAR and GIS catalogues, Luca Bianchini Ciampoli, Valerio Gagliardi, Alessandro Calvi, Fabrizio D’Amico, Univ. degli Studi di Roma Tre (Italy); Fabio Tosti, Univ. of West London (United Kingdom) ................................................................. [11059-17]

9:40: Methodology for utilization of a generalised antenna in grpMax simulator, Sumonta Chatterjee, Amlabha Bhattacharya, Indian Institute of Technology Kharagpur (India); Swati Duggal, Space Applications Ctr., (India) ................................................................. [11059-18]

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

SESSION 4

LOCATION: ICM, 12B ............................. THU 10:30 TO 12:10

Hyperspectral Imaging Applications

Session Chairs: Salah Bourennane, Ecole Centrale de Marseille (France); Nicola Mosca, Consiglio Nazionale delle Ricerche (Italy)

10:30: Palm-sized and tough two-dimensional spectroscopic imager: the so-called hyperspectral camera for visible and mid-infrared light. Proposal of plant-species identification regardless of zenith and azimuth angles based on only two types of basic spectroscopic data (near-surface and internal reflectance), Hanyang Ke, Natsumi Kawashima, Sora Muztani, Tomoya Kitazaki, Satoru Adachi, Jyunya Iwaki, Kotone Yokoyama, Ichiro Ishimaru, Kagawa Univ. (Japan) ................................................................. [11059-31]

10:50: Unsupervised feature extraction based on improved Wasserstein generative adversarial network for hyperspectral classification, Qiaojiao Sun, Salah Bourennane, Ecole Centrale de Marseille (France) ................................................................. [11059-32]

11:10: Target detection based on classification in shadow region of hyperspectral image, Xuefeng Liu, Congcong Wang, Qingdao Univ. of Science and Technology (China); Min Fu, Ocean Univ. of China (China); Salah Bourennane, Institut Fresnel (France) and Ecole Centrale de Marseille (France) ................................................................. [11059-33]

11:30: Overview of tensor-based processing methods to improve classification and detection results in hyperspectral images, including the case of signal dependant noise and small targets, Caroline Fossati, Salah Bourennane, Institut Fresnel (France) ................................................................. [11059-34]

11:50: Hybrid spectroscopic microscopy for the characterization of dried DNA samples, Vassilis M. Papadakis, George Kenizakis, Foundation for Research and Technology-Hellas (Greece) ................................................................. [11059-35]

Lunch Break .................................... Thu 12:10 to 13:20
SESSION 5

LOCATION: ICM, 12B  ................. THU 13:20 TO 15:30

Machine Learning Applications

Session Chairs: Cosimo Distante, Univ. del Salento (Italy); Luiz Marcos Garcia Goncalves, UFRN (Brazil)

13:20: Multimodal data fusion for object recognition, Vladimir A. Knyaz, GosNIIAS (Russian Federation) .............................. [11059-19]
13:40: Deep learning approaches to EEG feature extraction (Invited Paper), Francesco Carlo Morabito, Univ. Mediterranea di Reggio Calabria (Italy) .................................................. [11059-20]
14:10: Challenges of hand recognition and interpretation for a manual assembly assistance system, Martin Root, Christian Jauch, Fraunhofer-Institut für Produktionstechnik und Automatisierung (Germany) .............................. [11059-21]
14:30: Convolutional neural networks for recognition and segmentation of aluminum profiles, Pier Luigi Mazzeo, Arturo Argentieri, Istituto di Scienze Applicate e Sistemi Intelligenti "Eduardo Caianiello" (Italy); Federico De Luca, Univ. del Salento (Italy); Paolo Spagnolo, Cosimo Distante, Marco Leo, Pier Luigi Carcagni, Istituto di Scienze Applicate e Sistemi Intelligenti "Eduardo Caianiello" (Italy) .................................................. [11059-22]
14:50: Scene disparity estimation with convolutional neural networks, Essa Anas, Li Guo, Ahmed Onsy, Bogdan Matuszewski, Univ. of Central Lancashire (United Kingdom) .................................................. [11059-23]
15:10: Image quality evaluation and CNN segmentation of thermal cutting edges using a mobile device, Omar De Mitri, Univ. del Salento (Italy); Janek Stahl, Christian Jauch, Fraunhofer-Institut für Produktionstechnik und Automatisierung (Germany); Cosimo Distante, Univ. del Salento (Italy) .................................................. [11059-24]

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

SESSION 6

LOCATION: ICM, 12B  ................. THU 16:00 TO 18:10

Multimodal Sensing Applications

Session Chairs: Andrei G. Anisimov, Technische Univ. Delft (Netherlands); Michele Meo, Univ. of Bath (United Kingdom)

16:00: Hyperspectral image segmentation based on the estimation of the multiway signal subspace dimension, Pierre Delmas, Caroline Fossati, Salah Bourennane, École Centrale de Marseille (France) .................................................. [11059-25]
16:20: Multimodal nondestructive inspection of impact damages in composite laminates: a case study to assess the damage volume (Invited Paper), Andrei G. Anisimov, Technische Univ. Delft (Netherlands); Mariya G. Serikova, NPk Electron, Ltd. (Russian Federation); Nan Tao, Chirag Anand, Fardin Esrail, Christos Kassapoglou, Roger M. Groves, Technische Univ. Delft (Netherlands) .................................................. [11059-26]
16:50: Multimodal calibration of laser optics for sensor guided remote cutting, Daniel Valencia, Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (Germany); Benjamin Schulze, Fraunhofer-Institut für Fertigungstechnik Materialforschung (Germany); Christian Möller, Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (Germany); Jörg Wollnack, Technische Univ. Hamburg-Harburg (Germany) and Fraunhofer-Institut für Fertigungstechnik Materialforschung (Germany) .................................................. [11059-27]
17:10: An effective approach for 3D point cloud registration in railway contexts, Cosimo Patruno, Roberto Coella, Massimiliano Nitti, Ettore Stella, Consiglio Nazionale delle Ricerche (Italy) .................................................. [11059-28]
17:30: Multiple honey bees tracking and trajectory modeling, Baptiste Magnier, Behrang Moradi, Pierre R. Slangen, Faysal Bougarnale, Elyahou Gabbay, François Pfeifer, Mines Alès (France) .................................................. [11059-29]
17:50: New applications of electronic speckle pattern interferometry in novel materials and structures, Vito Pagliarulo, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti "Eduardo Caianiello" (Italy) .................................................. [11059-30]
Optical Methods for Inspection, Characterization, and Imaging of Biomaterials IV

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 Universitats Innsbruck (Austria); Christoph K. Hitzenberger, Medizinische Universitats 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); Pasquale Memmolo, Istituto di Scienze Applicate e Sistemi Intelligenti (ISASI-CNR) (Italy); Fernando Mendoza Santoyo, Ctr. de Investigaciones en Optica, 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, Santoyo, Ctr. de Investigaciones en Óptica, A.C. (Mexico); Lisa Miccio, Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); Pasquale Memmolo, Istituto di Scienze Applicate e Sistemi Intelligenti (ISASI-CNR) (Italy); Natan Wang, Univ. of Washington (USA); Zeev Zalevsky, Bar-Ilan Univ. (Israel)


MONDAY 24 JUNE

SESSION 1
LOCATION: HALL A1, ROOM GUSTAV HERTZ
MON 8:30 TO 10:00

Advanced Microscopy Modalities

Session Chair: Lisa Miccio, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy)

8:30: Fluorescence and scattering, a tug of war towards multimessenger optical microscopy (Keynote Presentation), Alberto Diaspro, Istituto Italiano di Tecnologia (Italy) and Univ. degli Studi di Genova (Italy).

9:00: Design and implementation of a compact high-throughput echelle spectrometer using off-the-shelf off-axis parabolic mirrors for analysis of biological samples by LIBS, Hamed Abbasi, Georg Rauter, Raphael Guzman, Philippe C. Cattin, Ashar Zam, Univ. Basel (Switzerland).

9:20: Video rate scanning endomicroscopy through a coherent fiber bundle using a galvo scanner, Elias Scharf, Robert Kuschmierz, Jürgen W. Czarske, TU Dresden (Germany).


SESSION 2
LOCATION: HALL A1, ROOM GUSTAV HERTZ
MON 11:20 TO 12:50

Advanced Diagnostics by Speckle Techniques

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


11:50: Detection of self-propelling bacteria by speckle correlation assessment and applications to food industry, Vittorio Bianco, David D. Sampson, The Univ. of Western Australia (Australia); Natan Wang, Univ. of Washington (USA); Romina Rega, Pietro Ferraro, Simonetta Grilli, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy).

12:10: In-plane deformation gradient measurement using common-path spatial phase shift shearography, Hella Hooshmand-Zaﬁa, Shahid Beheštî, Univ. (Iran, Islamic Republic of); Hosrow Hassan, Univ. of Tehran (Iran, Islamic Republic of); Masoomeh Dashtdar, Shahid Beheštî, Univ. (Iran, Islamic Republic of); Khosrow Hassani, Univ. of Tehran (Iran, Islamic Republic of); Helia Hooshmand-Ziaﬁ, Shahid Beheštî, Univ. (Iran, Islamic Republic of); Helia Hooshmand-Ziaﬁ, Shahid Beheštî, Univ. (Iran, Islamic Republic of).

12:30: A pyroelectric-based system for sensing low abundant lactose molecules, Romina Rega, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Juan Francisco Muñoz Martínez, Universidad Politecnica de Madrid (Spain); Martina Mughnana, E. Oledandro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Oriella Gennari, Istituto Nazionale di Ottica (Italy); P. Orlando, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy). Lunch Break.

SESSION 3
LOCATION: HALL A1, ROOM GUSTAV HERTZ
MON 13:50 TO 15:55

Digital Holography

Session Chair: Pierre P. Marquet M.D., Ctr. de Recherche de l’Univ. Laval Robert-Giffard (Canada)


14:20: A review on optical methods to assess dental behavior under stress (Invited Paper), Pascal Picart, Lab. d’Acoustique de l’Univ. de Lille (France); Michel Fages, Univ. Montpellier (France); Oriella Gennari, Istituto Nazionale di Ottica (Italy); P. Orlando, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Maria Dolores del Rio, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Exequield’Orlando, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy).
14:50: Morphology and spatial refractive index distribution of the retina accessed by hyperspectral quantitative phase microscopy, Álvaro Barrosio Peha, Steffi Ketelhut, Peter Heiduschka, Gerburg Nettels-Hackert, Jürgen Schnekenburger, Björn Kemper, Westfälische Wilhelms-Universit, Münster (Germany) .............................................. [11060-11]

15:10: Matched filter applied to discriminate particles with different sizes in biological fluids, Marina Gómez Climente, Julia Lobera Salazar, Virginia Palero-Díaz, M. Pilar Arroyo de Grandes, Univ. de Zaragoza (Spain) [11060-12]

15:30: Imaging the competition between growth and production of self-assembled lipid droplets at the single-cell level (Invited Paper), Andreas E. Vasdekis, Hamdah Alanazi, Univ. of Idaho (USA); Andrew M. Silverman, (Invited Paper) assembled lipid droplets at the single-cell level, Andreas 

LOCATION: HALL A1, ROOM GUSTAV HERTZ ............... MON 16:15 TO 17:35
Learning Approaches in Microscopy I
Session Chair: Jürgen W. Czarske, TU Dresden (Germany)

16:15: Toward a thinking microscope: deep learning-enabled computational microscopy and sensing (Keynote Presentation), Aydogan Ozcan, Univ. of California, Los Angeles (USA) ............................. [11060-14]

16:45: Applications of deep learning in computational imaging (Invited Paper), Guohai Situ, Hao Wang, Fei Wang, Shanghai Institute of Optics and Fine Mechanics (China) .................................. [11060-15]

17:15: Identification and classification of biological micro-organisms by holographic learning, Pasquale Memmolo, Vittorio Blanco, Pierluigi Carcagni, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Andigas Golcanves da Silva Junior, Luis Marcos Garcia Goncalves, Univ. Federal do Rio Grande do Norte (Brazil); Francesco Merola, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Andigas Golcanves da Silva Junior, Luis Marcos Garcia Goncalves, Univ. Federal do Rio Grande do Norte (Brazil); Francesco Merola, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) .................. [11060-16]

SESSION 4

LOCATION: HALL A1, ROOM GUSTAV HERTZ ................. MON 16:15 TO 17:35
Learning Approaches in Microscopy I
Session Chair: Jürgen W. Czarske, TU Dresden (Germany)

16:15: Toward a thinking microscope: deep learning-enabled computational microscopy and sensing (Keynote Presentation), Aydogan Ozcan, Univ. of California, Los Angeles (USA) ............................. [11060-14]

16:45: Applications of deep learning in computational imaging (Invited Paper), Guohai Situ, Hao Wang, Fei Wang, Shanghai Institute of Optics and Fine Mechanics (China) .................................. [11060-15]

17:15: Identification and classification of biological micro-organisms by holographic learning, Pasquale Memmolo, Vittorio Blanco, Pierluigi Carcagni, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Andigas Golcanves da Silva Junior, Luis Marcos Garcia Goncalves, Univ. Federal do Rio Grande do Norte (Brazil); Francesco Merola, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Andigas Golcanves da Silva Junior, Luis Marcos Garcia Goncalves, Univ. Federal do Rio Grande do Norte (Brazil); Francesco Merola, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) .................. [11060-16]

SESSION 5

LOCATION: HALL A1, ROOM GUSTAV HERTZ ................. TUE 08:20 TO 10:00
Understanding Biomechanics by Optical Methods I
Session Chair: Kirill V. Larin, Univ. of Houston (USA)

8:20: Substrate developments for exploring living cells in culture with quantitative phase imaging: towards label-free high-content screening (Invited Paper), Pierre P. Marquet M.D., Ctr. de Recherche de l’Univ. Laval (Canada); Bertrand de-Dorlodot, Émile Rioux-Pélerin, Sébastien Lévesque, CERVO Brain Research Ctr. (Canada) .................. [11060-17]

8:50: Engineering light-responsive substrates for the dynamic display of Metamaterial structure for potential image processing, Bakholdin, ITMO Univ. (Russian Federation) .................. [11060-48]

VINGTS (France); Mathias Foray, Institut Langevin Ondes et Images (France); Annamaria Cucinotta, Francesco Biasion, Matteo Barozzi, Univ. degli Studi di Parma (Italy) .......... [11060-22]

11:30: Analysis of retinal and choroidal images measured by laser Doppler holography (Invited Paper), Leo Puyo, Institut Langevin Ondes et Images (France); Michel Pâques, Ctr. Hospitaller National d’Ophthalmologie des Quinze-Vingts (France); Mathias Foray, Institut Langevin Ondes et Images (France); José-Alain Sahel, Ctr. Hospitaller National d’Ophthalmologie des Quinze-Vingts (France); Michael Atlan, Institut Langevin Ondes et Images (France) [11060-23]

POSTERS-TUESDAY

LOCATION: ICM, HALL B0 ......................... TUE 12:05 TO 12:40
Conference attendees are invited to attend the Optical Metrology Poster Session I 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 12:05 through 12:40 hrs on Tuesday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/x6513.xml . (Follow the Special Events link)

The effect of particle aspect ratio on spatially and angularly resolved vis-NIR spectroscopy of suspensions, Ilya Stoliar, Thresky Thomson, Leo Luk, Yi-Chieh Chen, Univ. of Strathclyde (United Kingdom) .................. [11060-45]

3D manipulation of micro-objects based on optical tweezers using acousto-optic deflector and variofocal system, Yulia Pichugina, Scientific and Technological Ctr. for Unique Instrumentation (Russian Federation); Pavel A. Nosov, Vadislav I. Batshev, Bauman Moscow State Technical Univ. (Russian Federation); Alexander S. Machikhin, Alexey Kozlov, Scientific and Technological Ctr. for Unique Instrumentation (Russian Federation); George Krasin, Bauman Moscow State Technical Univ. (Russian Federation)[11060-66]

Effect of nanoparticle polyethylene glycol surface density for biomaterials: toward redesigning the PEG surface of nanocarriers, Sungwon Hyang, Sangmyung Univ. (Korea, Republic of) .................. [11060-47]

Optical design of infrared endoscope systems for laparoscopic surgery, Alisa S. Ekimenkova, Alexandra Bode, Anna O. Voznesenskaya, Alexey Bakhholdin, ITMO Univ. (Russian Federation) .................. [11060-48]

Metamaterial structure for potential image processing, Hongwei Sun, Jiangsu Automation Research Institute (China) .................. [11060-49]

Characterization of microplastics by holographic features for automatic detection in heterogeneous samples, Vittorio Blanco, Pasquale Memmolo, Francesco Merola, Pierluigi Carcagni, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) .................. [11060-50]

In vivo skin surface study by scattered ellipsometry method, Anastasia B. Bulykina, Victoria A. Ryzhova, Valery V. Korotaev, ITMO Univ. (Russian Federation) .................. [11060-51]
A method for reconstruction of terahertz dielectric response of thin liquid samples, Arseniy A. Gadush, A.M. Prokhorov General Physics Institute of the RAS (Russian Federation); Vladislav Ulitko, Bauman Moscow State Technical Univ. (Russian Federation); Guzei R. Musina, Bauman Moscow State Technical Univ. (Russian Federation) and A.M. Prokhorov General Physics Institute of the RAS (Russian Federation); Irina N. Dolganova, Bauman Moscow State Technical Univ. (Russian Federation) and Institute of Solid State Physics of the Russian Academy of Sciences (Russian Federation) and Sechenov First Moscow State Medical University (Russian Federation); Nikita V. Chernomyrdin, A.M. Prokhorov General Physics Institute of the RAS (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation); Vladimir N. Kurov, Institute of Solid State Physics of the Russian Academy of Sciences (Russian Federation); Gennady A. Kornandin, A.M. Prokhorov General Physics Institute of the RAS (Russian Federation); Valery V. Tuchin, Saratov State University (Russian Federation) and ITMO University (Russian Federation) and Institute of Precision Mechanics and Control of the Russian Academy of Sciences (Russian Federation); Kirill I. Zaytsev, A.M. Prokhorov General Physics Institute of the RAS (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation). [11060-52]

Intensity favored switching of nonlinear optical absorption mechanism in silver nanoparticles under nanosecond pulsed laser excitation, Sharafuddin Kaniyarakkal Naduvali Yapialip, Kuwait College of Science and Technology (Kuwait); Siji Narendran N. K., T. K. Madhava Memorial College (India); Shiju E., Department of Physics, National Institute of Technology Calicut (India); Vijayakumar S, Department of Physics, NIS College Pandalam (India); Chandrasekharan Keloth, National Institute of Technology Calicut (India). [11060-53]

Local orthostatic maneuver in the optical diagnosis of peripheral blood oxygenation, Sylwester Nowocien, Wroclaw Univ. of Science and Technology (Poland). [11060-54]

Lunch Break. [11060-55]
SESSION 10

LOCATION: HALL A1, ROOM GUSTAV HERTZ ............... WED 11:30 TO 12:40

Thermal Imaging for Medicine and Biotechnology

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

11:30: Photo-activated thermal imaging at subdiffraction resolution (Invited Paper), Margaux Bouzin, Mario Marii, Amirbahador Zeynali, Univ. degli Studi di Milano-Bicocca (Italy); Laura Sironi, Laura D’Alfonso, Francesca Mingozzi, Francesca Granucci, Giuseppe Chirico, Maddalena Collini, Univ. degli Studi di Milano-Bicocca (Italy) ..................................... [11060-35]

12:00: Sources of uncertainty in the evaluation of thermal images in medicine, Kurt Ammer M.D., European Association of Thermology (Austria) ................................................ [11060-36]

12:20: Toward single cell thermal biology, Guillaume Baffou, Institut Fresnel (France) ................................................ [11060-37]

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

SESSION 11

LOCATION: HALL A1, ROOM GUSTAV HERTZ ............... WED 16:00 TO 17:40

Phase Contrast Tomography: New Trends

Session Chair: Christoph K. Hitzenberger, Medizinische Univ. Wien (Austria)

16:00: Quantitative phase imaging and artificial intelligence (Keynote Presentation), Geon Kim, KAIST (Korea, Republic of); Hyunjo Cho, Tomocube, Inc. (Korea, Republic of); Donghun Ryu, KAIST (Korea, Republic of); Hyeonseok Min, Tomocube, Inc. (Korea, Republic of); YongKeun Park, KAIST (Korea, Republic of) ........................................... [11060-40]

16:30: Fast label-free optical diffraction tomography compatible with conventional wide-field microscopes (Invited Paper), José A. Rodrigo, Juan M. Soto, Tatiana Aliev, Univ. Complutense de Madrid (Spain) .......... [11060-41]

17:00: Holographic processing pipeline for tomographic flow cytometry, Pietro Ferraro, Francesco Merola, Lisa Miccio, Pasquale Mammolo, Martina Mugnano, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) ................................................ [11060-42]

17:10: BM3D filtration in holographic tomography reconstruction, Piotr Stepiew, Michal Ziemczonok, Arkadiusz T. Kusi, Malgorzata Kujawińska, Warsaw Univ. of Technology (Poland) ................................................ [11060-44]

Joint Session between SPIE Optical Metrology Conferences 11059 and 11060.


14:10: Automated cell identification with 3D optical imaging (Keynote Presentation), Bahram Javidi, Univ. of Connecticut (USA); Anun Anand, The Maharaja Sayajirao Univ. of Baroda (India); Timothy O’Connor, Univ. of Connecticut (USA); Inkyu Moon, Daeeg Gyeongbuk Institute of Science & Technology (Korea, Republic of); Adam S. Markman, Univ. of Connecticut (USA) ........................................................................ [11059-38]

14:45: Holographic imaging of erythrocytes in acoustofluidic platforms, Teresa Cacace, Pasquale Mammolo, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Massimiliano M. Villone, Univ. degli Studi di Napoli Federico II (Italy); Marco De Corato, Imperial College London (United Kingdom); Melania Paturzo, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); Pier Luca Maffettone, Univ. degli Studi di Napoli Federico II (Italy); Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) ................................................ [11059-43]

15:05: How holographic imaging can improve machine learning, Pasquale Mammolo, Vittorio Blanco, Pierluigi Carcagni, Francesco Merola, Melania Paturzo, Cosimo Distante, Pietro Ferraro, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy) ................................................ [11059-7]

Coffee Break ........................................... Wed 15:25 to 16:00
Conference Chairs: Jürgen Beyerer, Fraunhofer-Institut für Opttronik, Systemtechnik und Bildauswertung (Germany); Fernando Puente León, Karlsruher Institut für Technologie (Germany).

Programme Committee: Christian Frese, Fraunhofer-Institut für Opttronik, 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 Opttronik, 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 Thiennon, Vrije Univ. Brussel (Belgium); Stefan Werling, Duale Hochschule Baden-Württemberg (Germany); Ernst Wiedemann, Serious Enterprises (Germany); Volker Willert, Technische Univ. Darmstadt (Germany).

THURSDAY 27 JUNE

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

Image Acquisition

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

10:30: A simulation framework for the design and evaluation of computational cameras. Thomas Nürnberg, Maximilian Schambach, David Uhlig, Michael Heizmann, Fernando Puente León, Karlsruher Institut für Technologie (Germany). [11061-1]

10:50: Robust phase unwrapping based on non-coprime fringe pattern periods for deflectometry measurements. Stephan Allgeier, Ulrich Gengenbach, Bernd Köhler, Klaus-Martin Reichert, Velt Hagenmeyer, Karlsruher Institut für Technologie (Germany). [11061-2]


POSTERS-THURSDAY

LOCATION: ICM, HALL B0  .. THU 11:30 TO 12:30

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 11:40 through 12:40 hrs on Thursday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/e513.xml. (Follow the Special Events link)

Region of interest detection based on visual saliency analysis and iteratively clustering for remote sensing images. Yang Sun, Shuang Wang, Libao Zhang, Beijing Normal Univ. (China). [11061-8]


Medical image segmentation based on the modified model of active contour in a quaternion framework. Yuriy Zaiser, Vitaly Murashev, Elena V. Gorlach, ITMO Univ. (Russian Federation). [11061-10]

Image filtering and analysis based on non-stationary wavelet transform. Irina Popova, University of St. Petersburg (Russian Federation). [11061-11]

Image filtering using morphological thickness map. Stanislav Brinisky, Moscow Aviation Institute (Russian Federation); Boris V. Vasilyanov, Vladimir S. Gorbatsevich, Yuriy Zaiser, Ostafe Gorni, ITMO Univ. (Russian Federation). [11061-9]


Analysis of filtering algorithms and searching for objects on the video image during the “Morris water maze” and “Open field” experiments. Ksenia Ezhova, Andrey Veremenko, ITMO Univ. (Russian Federation); Ksenia Baranova, Pavlov Institute of Physiology (Russian Federation); Anastasia Tropova, St. Petersburg State Chemical Pharmaceutical Academy (Russian Federation). [11061-14]


On 2D pulsed TOF surface profiling in earth construction, Ippo O. Niskanen, Matti Immonen, Torri Makkonen, Pekka Hiltunen, Jaana Kostamovaa, Rauno Heikkilä, Univ. of Oulu (Finland). [11061-17]


Regions of interest detection based on foreground distribution and background prior in remote sensing images, Yang Sun, Libao Zhang, Beijing Normal Univ. (China). [11061-21]

Problem solution for stitching groups of the images obtained only in the infrared range. Evgeny A. Semenishchew, Vlacheslav V. Voronin, Aleksandr Zelenksy, Moscow State Univ. of Technology “Stankin” (Russian Federation). [11061-24]

Surface characterization of conventional milled surfaces using machine vision approach, Sourabh Adus, Sivasivasubhav Devadac, Indian Institute of Technology Madras (India). [11061-25]

Lunch Break .................................................. THU 12:30 to 14:00

SESSION 2

LOCATION: ICM, 12A  .. THU 14:00 TO 15:00

Inspection, Measurement, and Control

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

14:00: An advanced method for matching partial 3D point clouds to freeway CAD models for in-situ inspection and repair. Bilal Nasser, Rolls-Royce Power Engineering plc (United Kingdom); Amir Rabani, Digital Catapult (United Kingdom). [11061-5]

14:20: Optical inspection of noncooperative copper surface structures using multi- and hyperspectral acquisition systems. Markus Wrieden, Andreas Brettbath, Technische Univ. Ilmenau (Germany); Manuel Zimmermann, Jörg Scharmbach, GOPEL electronic GmbH (Germany); Maik Rosenberger, Technische Univ. Ilmenau (Germany). [11061-6]

14:40: Automated inspection of optical surface cleanliness. Daniel Kiefhaber, Peter Würzt, Fabian Etzold, Willi Maurer, Jean-Michel Asfour, Diopotic GmbH (Germany). [11061-7]
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- Frank Wyrowski, LightTrans International UG (Germany)
Digital Optical Technologies II

Conference Chairs: Bernard C. Kress, Microsoft Corp. (USA); Peter Schelkens, Vrije Univ. Brussel (Belgium)

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MONDAY 24 JUNE

WORLD OF PHOTONICS CONGRESS-WIDE PLENARY SESSION
LOCATION: ICM, SAAL 1 .......... MON 10:00 TO 11:00
Listening to the universe with gravitational waves
Karsten Danzmann, Max Planck Institute for Gravitational Physics and Leibnitz Univ. Hannover (Germany)

Coffee Break ..................................... Mon 11:00 to 11:15
Lunch Break ..................................... Mon 11:15 to 13:00

SPIE DIGITAL OPTICAL TECHNOLOGIES PLENARY SESSION
LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW .......... MON 13:00 TO 14:00
13:00 to 13:15: Welcome and Introduction
Bernard C. Kress, Microsoft Corp. (USA); Peter Schelkens, Vrije Univ. Brussel (Belgium)
13:15 to 14:00: Light field image processing: overview and research problems
Christine Guillemot, INRIA, France

SESSION 1
LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW .......... MON 14:00 TO 15:40
3D Display Techniques and Technologies
Session Chair: Bernard C. Kress, Microsoft Corp. (USA)
14:00: Design and fabrication of flexible naked-eye 3D display thin film device based on micro electrostructure, Axiu Cao, Institute of Optics and Electronics (China); Lifang Shi, Hui Pang, Qiling Deng, Song Hu, Institute of Optics and Electronics (China) . . . . . . . . . . . . . . . [11062-1]
14:20: Large-scale full-color computer-generated display holograms created by stacking transferred volume holograms, Orie Kunieda, Kyoji Matushima, Kansai Univ. (Japan) . . . . . . . . . . . . . . . [11062-2]
14:40: Exact mask-based occlusion processing in large-scale computer holography for 3D display, Kenta Nakamoto, Kyoji Matushima, Kansai Univ. (Japan) . . . . . . . . . . . . . . . [11062-3]
15:00: Epipolar-like image analysis for projection-based light field displays, Olekai Doronin, Attila Barsi, Holografika Kft. (Hungary) . . . . . . . . . . . . [11062-4]
15:20: Design of free-form surface backlight unit for displays, Nikolai I. Petrov, Scientific and Technological Ctr. for Unique Instrumentation (Russian Federation) . . . . . . . . . . . . . . . [11062-5]
Coffee Break ..................................... Mon 15:40 to 16:10

SESSION 2
LOCATION: ARTHUR SCHAWLOW, HALL A1 .......... MON 16:10 TO 17:50
Switchable, Tunable and Reconfigurable Optics
Session Chair: Svetlana Samoilova, NewSight Reality (USA)
16:10: Tunable filter using birefringent plasmonic structures and liquid crystals, Benjamin Gallinet, Ctr. Suisse d’Electronique et de Microtechnique SA (Switzerland); Dimitrios Kazazis, Yasin Ekinci, Paul Scherrer Institut (Switzerland); François Federspiel, Richard Frantz, Rolic Technologies Ltd. (Switzerland); Rolando Ferrini, Luc Driencourt, Ctr. Suisse d’Electronique et de Microtechnique SA (Switzerland) . . . . . . . . . . . . . . . [11062-6]
16:30: Optically computational 3D structural measuring approaches and integration architecture with digitally reconfigurable digital optics array platform, Cheng-Feng Yue, Jasper Display Corp. (Taiwan) . . . . . . . . . . . . . . . . . . . [11062-7]
16:50: Broadband visible reflective metasurfaces for the visualisation of 3D effects, Diane J. Roth, Alexander E. Minovich, King’s College London (United Kingdom); Guixin Li, Southern Univ. of Science and Technology of China (China); Anatoly V. Zayats, King’s College London (United Kingdom) [11062-8]
17:10: 1×4 VLC wavelength demultiplexer based on multilayer waveguide structures, Moriel Gindi II, Amit Melamed D.D.S., Dror Malak, Holon Institute of Technology (Israel) . . . . . . . . . . . . . . . [11062-9]
17:30: Design of a tunable automotive light system with high collimated light engine for adaptive headlight system application, Luan-Ying Chen, Industrial Technology Research Institute (Taiwan); Ju-Wen Pan, National Chiao Tung Univ. (Taiwan); Kao-Der Chang, National Central Univ. (Taiwan) [11062-10]
SESSION 3

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............ TUE 8:00 TO 10:00

Novel Optics for Augmented, Mixed and Virtual Reality Systems (AR, MR, VR)
Session Chair: Christian Hellmann, Wyrowski Photonics UG (Germany)

8:00: Crystal: an optical train for upsacle VR (Invited Paper), Pablo Benitez, Dejan Grabovickic, Marina Buljan, Milena I. Nikolic, Julio Cesar Pinto Chaves, Juan C. Mirano, Pablo Zamora, Ruben Mohedano, Limbak 4PI S.L. (Spain) ................................................................. [11062-71]

8:30: NewSight Reality Inc. (NSR) novel transparent optical module for augmented reality glasses (Invited Paper), Svetlana Samoilova, NewSight Reality (USA); Amitava Gupta, Foresightvision Inc. (USA); Roland Blum, NewSight Reality (USA); Igor Landau, OpticsWorks Inc. (USA) ........ [11062-11]

9:00: A novel approach to freeform optimization: designing an eye-tracking augmented reality system using grid-based sag optimization, Zachary Derocher, Shawn Gay, Ken Moore, Zemax, LLC (USA) ........ [11062-12]


11:00: Innovative systematic design approach for lightguide devices for XR applications, Christian Hellmann, Wyrowski Photonics UG (Germany); Stefan Steiner, Roberto Knoth, Site Zhang, LightTrans International UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) .... [11062-14]

Coffee Break ......................................................... Tue 10:00 to 10:35

SESSION 4

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............ TUE 10:35 TO 12:50

Waveguide Optics for AR/MR Systems
Session Chair: Sébastien de Cunsel, WaveOptics Ltd. (United Kingdom)

10:35: Optical design of a thin curved lightguide and manufacturing using ophthalmic approaches (Invited Paper), Özcan Çakmakçi, Oscar Martínez, Jerry Carollo, Google (USA) ........................................ [11062-15]

11:00: Physical-optics analysis of lightguides for augmented and mixed reality glasses, Christian Hellmann, Wyrowski Photonics UG (Germany); Stefan Steiner, Roberto Knoth, Site Zhang, LightTrans International UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) .......... [11062-16]

11:20: Features and limitations of waveguide combiner architectures for augmented reality headsets, Bernard C. Kress, Microsoft Corp. (USA) ..................................................... [11062-17]

11:40: Physical-optical analysis of lightguide coupling setup and systematic design strategy, Roberto Knoth, Stefan Steiner, Site Zhang, LightTrans International UG (Germany); Christian Hellmann, Wyrowski Photonics UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) ........ [11062-18]

12:00: Waveguide grating combiner for small form factor smart glasses (Invited Paper), Antti Sunnari, Dispex Oy (Finland) ................ [11062-19]

12:30: Waveguide optics enabled consumer HUD’s, revolutionizing AR transportation applications, Jonathan D. Waldern, Alastair J. Grant, DigiLens Inc. (USA); Milan M. Popovich, DigiLens, Inc. (United Kingdom) ......... [11062-22]

Lunch Break .......................................................... Tue 12:50 to 13:50

SESSION 5

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............ TUE 13:50 TO 15:30

Digital Optics for Image Formation
Session Chair: Aleksandra Pedraszewska, VividQ Ltd., (United Kingdom)

13:50: 3D imaging systems based on projectors and mobile phones, Nikolai I. Petrov, Maxim N. Khromov, Vladimir G. Nikitin, Scientific and Technological Ctr. for Unique Instrumentation (Russian Federation); Yuri M. Sokolov, RUDN Univ. (Russian Federation) .................................................. [11062-20]

14:10: PixMap: automatic license plate recognition with convolutional neural network based on saliency maps, Aissan Sanogo, Arcad Llanza, Nadia Shvai, Abul Hasnat, Marouan Khata, Yassine El Khattabi, Antoine Mecler, Alice Hemyer, cyclope.ai (France); Amir Nakib, Univ. Paris-East Créteil (France) .................................................. [11062-21]

14:30: Holistic optimization of optical systems, Kumar Rishav, Carsten Reichert, Alois Herkommer, Institut für Technische Optik (Germany) [11062-22]

14:50: Research on influences of atmospheric turbulence on long-distance Fourier ptychographic imaging, Mingyang Yang, Xi’an Institute of Optics and Precision Mechanics (China) and Univ. of Chinese Academy of Sciences (China); Xuewu Fan, Hui Zhao, Chuan Li, Xi’an Institute of Optics and Precision Mechanics (China); Meng Xiang, Xi’an Institute of Optics and Precision Mechanics (China) and Univ. of Chinese Academy of Sciences (China) .................................................. [11062-23]

15:10: Investigation the effect of shapes, size and orientation of dielectric rods on the photonic band gap for various lattices in 2D anisotropic photonic crystals, Mahsa Hadadi Moghadam, Behrooz Rezaei, Ali Soltani Vala, Manoochehr Kalafi, Univ. of Tabriz (Iran, Islamic Republic of) .... [11062-25]

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

SESSION 6

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............ TUE 16:00 TO 17:45

Increasing Visual Comfort in 3D Displays
Session Chair: Kriss Osmanis, Lightspace Technologies, SIA (Latvia)

16:00: Accommodation cue vs. compute: context dependent dynamic layer allocation in holographic display, Omer Tastemur, Tom Durrant, Andray Kaczorowski, Darran Milne, VividQ Ltd. (United Kingdom) .... [11062-73]

16:20: Accommodation corrected 3D displays using spatial volume demultiplexer chip, Kriss Osmanis, Robert Zabelis, Lightspace Technologies, SIA (Latvia); Anura Cols, EuroLCDs (Latvia); Martinš Narels, Lightspace Technologies, SIA (Latvia); Ugis Gertners, Hansamatrix Innovation (Latvia); Karlis Rutenbergs, Hansamatrix Ventspils (Latvia); Ilmars Osmanis, Lightspace Technologies, SIA (Latvia) and Univ. of Chinese Academy of Sciences (China) .................................................. [11062-27]

16:40: Advanced screen-space ambient occlusion on HoleVizio 3D display, Okeksi Doronin, Attila Barsi, Holografika Kft. (Hungary) ................ [11062-28]

17:00: Evaluation of AR displays performances based on human visual perception, Sébastien de Cunsel, WaveOptics Ltd. (United Kingdom) .................. [11062-29]

17:25: Analysis of the visual perception conflicts in the mixed reality systems with the real-world illumination parameters restoration, Andrej Zhdanov, Dmitry Zhdanov, Igor S. Potemin, Nikolay Bogdanov, ITMO Univ. (Russian Federation) ........................ [11062-30]
WEDNESDAY 26 JUNE

SESSION 7

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............. WED 8:20 TO 10:00

**Digital Optics for Display and Sensing**

Session Chair: Thomas Milde, Carl Zeiss AG (Germany)

8:20: High refractive index glass wafers for AR waveguide technology, Berthold Lange, SCHOTT AG (Germany) ........................................ [11062-74]

8:40: Enhanced field-of-view structured illumination projector using stacked microlens arrays, Rohan Kundu, Friedrich-Schiller-Univ. Jena (Germany); Peter Schreiber, Peter Dannberg, Stephanie Fischer, Chen Li, Uwe D. Zeitz, Andreas Tönnemann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ................................ [11062-31]

9:00: Inspection of surface imperfections via height contrast imaging based on angle selective illumination, Thomas Milde, Carl Zeiss AG (Germany); Christina Knechtel, Carl Zeiss SMT GmbH (Germany) .... [11062-32]

9:20: Ultraprecision angle measurement sensors with optimized size, weight and power, Edward R. Dowski Jr., Ascentia Imaging, Inc. (USA); Greg Johnson, nelson claylor, Ascentia Imaging (USA) ........ [11062-33]

9:40: Dot pattern generation using thick sinusoidal phase grating under Gaussian beam illumination, Maryam Yousefi, Toralf Scharf, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Markus Rossi, ams AG (Switzerland) ........................................ [11062-34]

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

SESSION 8

LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ............. WED 10:30 TO 11:50

**Computation Display and Imaging I**

Session Chair: Peter Schelkens, Vrije Univ. Brussel (Belgium)

10:30: Single exposure lensless subpixel phase imaging, Péter Kocsis, Toralf Scharf, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Markus Rossi, ams AG (Switzerland) ........................ [11062-35]

10:50: Increasing the accessible resolution range for computational ghost imaging based on Hadamard matrices, Robert Aare, Andreas Valdmann, Univ. of Tartu (Estonia) ................................................ [11062-36]

11:10: Optical quality metrics for image restoration, Patrick Müller, Matthias Lehmann, Alexander Braun, Hochschule Düsseldorf (Germany) ... [11062-37]

11:30: Computational imaging technology based on birefringent materials, Lifang Shi, Aixiu Cao, Institute of Optics and Electronics (China); Hui Pang, Institute of Optics and Electronics (China); Qiling Deng, Institute of Optics and Electronics (China) ........................................ [11062-38]

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

POSTERS-WEDNESDAY

LOCATION: ICM, HALL B0 ............... WED 12:50 TO 13:50

Conference attendees are invited to attend the Digital Optical Technologies Poster Session 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 12:50 through 13:50 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/x6513.xml. (Follow the Special Events link)

Design and research of lenses with a remote pupil and a telecentric beam path, Vasilisa Ezhova, Alexey Ikonnikov, Galina E. Romanova, Lev Andreev, ITMO Univ. (Russian Federation) ........................................ [11062-49]

Determination of sample surface microrelief by optical vortices superposition, Bogdan V. Sokolenko, Dmitrii Potelav, Nataliya Shostka, V.I. Vernadsky Crimean Federal Univ. (Ukraine) ........ [11062-50]

Arbitrary power splitting ratio on logic operation of NL-MMI, Mehdi Tajaldini, Graduate Univ. of Advanced Technology (Iran, Islamic Republic of); Mohamad Zuber Mat Jahi, Univ. Sains Malaysia (Malaysia) ........ [11062-51]

Automatised fine-focusing in digital microscopy, Petr Pokorny, Filip Smejkal, Pavel Novák, Czech Technical University in Prague (Czech Republic) ................................ [11062-52]

A method of increasing the depth-of-field of images of flat discrete transparencies, reconstructed using synthesized holograms, Marina Frolova, ITMO Univ. (Russian Federation) ................................ [11062-53]

Computational ghost imaging using the native aspect ratio of a digital light projector, Joan-Enric Arava, Andreas Valdmann, Jan Bogdanov, Univ. of Tartu (Estonia) ................................................ [11062-54]

Design of real-time compression and storage system for CoAxPress high-speed camera based on MPSoC FPGA, Qinkai Hou, Qiong Yao, Fuyin Wang, Hu Chen, Shudong Xiong, Chunyuan Cao, Weihua Zhang, Changliang Linghu, National Univ. of Defense Technology (China) ................................ [11062-55]

Formation and identification of atmospheric structure data by digital holography methods, Ekaterina Seledkina, Anton Ekineniko, ITMO Univ. (Russian Federation) ........................................ [11062-56]

Segmentation of illuminated areas of light using fully-convolutional neural networks and computer vision algorithms for augmented reality systems, Maxim Sorokin, Andrey Zhданов, Dmitry Zhданов, Igor S. Potemin, Nikolay Bogdanov, ITMO Univ. (Russian Federation) ........................ [11062-57]

Digital methods of impact on the image, Ksenia Ezhova, Anton Chukhtiamov, ITMO Univ. (Russian Federation) ........................................ [11062-58]

Simultaneous quantification of biomarkers using wax-patterned paper-polymer centrifugal optics, Sejin Kim, Dami Kim, Sanghyo Kim, Gachon Univ. (Korea, Republic of) ........................................ [11062-59]

Colorimetric detection of acetylcholinesterase using paper hybrid centrifugal fluidic on disc platform, Dami Kim, Sejin Kim, Sanghyo Kim, Gachon Univ. (Korea, Republic of) ........................................ [11062-60]

Graphene nonlinear optic all-optical switch based on multimode interference coupler, Mohammad Zuber Mat Jahi, Muhd. Adnin Abd. Hassim, Univ. Sains Malaysia (Malaysia) ................................ [11062-61]

Modeling and design of Vanguard high-NA projection lens with central obscuration, Aleksandr S. Grishkanchik, Aleksandr Zhevakloy, ITMO Univ. (Russian Federation) ........................................ [11062-62]

Increase of the magnetic information sensing performance of magneto-optical plasmonic structures, Stepan Baryshev, Alexey Kuznetsov, Sergey Odinokov, Bauman Moscow State Technical Univ. (Russian Federation) ........................................ [11062-63]

Review and analysis of optics for road lighting, Xuanlin Qiao, Galina E. Romanova, ITMO Univ. (Russian Federation) ........................................ [11062-64]

Design and aberration analysis of several AR optical architectures working with different sources of image, Tatiana A. Koneva, Galina E. Romanova, ITMO Univ. (Russian Federation) ........................................ [11062-65]

Experiments of DOEs for augmented reality indicator, Artem B. Solomashenko, Yanina Grad, Sergey Odinokov, Vladimir Nikolaeav, Dmitry Lushnikov, Vladimir Markin, Bauman Moscow State Technical Univ. (Russian Federation) ........................................ [11062-66]

Achromatic image rotator, Nikolai I. Petrov, Scientific and Technological Ctr. ITMO Univ. (Russian Federation) ........................................ [11062-67]

The efficient method of mixed reality light restoration using HDR image of 3D scene, Nikolay Bogdanov, Igor S. Potemin, Dmitry Zhданов, Andrey Zhданов, ITMO Univ. (Russian Federation) ........................................ [11062-68]
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Modified algorithm of 3D motion capture camera for martial power estimation, Nur Zaidi Azraai, Ahmad Aliq Sabqi M. Awang Soh, Mohamad Zubir Mat Jafri, Univ. Sains Malaysia (Malaysia) ........................... [11062-69]

An extrapolation-based method for improving the accuracy of phase retrieval with the transport of intensity equation, Zixin Zhao, Chen Fan, Xi’an Jiaotong Univ. (China); Jinlei Zhao, No.203 Research Institute of China Ordinance Industries (China); Yiying Zhuang, Hangying Zhang, Hong Zhao, Xi’an Jiaotong Univ. (China) ........................... [11062-70]

SESSION 9
LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ........... WED 13:50 TO 15:30

Computation Display and Imaging II
Session Chair: Tatiana A. Koneva, ITMO Univ., (Russian Federation)
13:50: Adaptation of tone mapping algorithms for light field displays, Oleksii Doronin, Attila Barsi, Holografika Kft. (Hungary) ............. [11062-40]
14:10: A plug-n-play framework and acquisition methodology for remote exploration systems with single pixel cameras, Protim Bhattacharjee, Anko Börner, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany),[11062-41]
14:30: Design of a spectral zoom imaging system, Xiaohu Guo, Chenxiao Zhao, Ping Zhou, Jingjing Zhu, Weimei Zhu, Zuming Kang, China North Vehicle Research Institute (China) ........................ [11062-42]
14:50: Study of peak to background-noise ratio for digital optical phase conjugator, Yeh-Wei Yu, Ching-Cherng Sun, National Central Univ. (Taiwan) ............................... [11062-43]
15:10: Automated, AI-driven reconfigurable phase contrast microscope for the diagnostic of fibers in air samples, David A. Mendels, xRapid-Group (France) ............................... [11062-44]

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

SESSION 10
LOCATION: HALL A1, ROOM ARTHUR SCHAWLOW ........... WED 16:00 TO 17:20

Computation Display and Imaging III
Session Chair: Bernard C. Kress, Microsoft Corp. (USA)
16:00: Improved vector extrapolation based Richardson-Lucy algorithm used for wavefront coded imaging and experimental demonstration, Hui Zhao, Jingjing Xia, Ling Zhang, Congcong Yu, Xuewu Fan, Xi’an Institute of Optics and Precision Mechanics (China) ........................ [11062-45]
16:20: Visibility enhancement for haze removal based on adaptive double opponentiness, Ruxi Xiang, Changzhou Institute of Technology (China) [11062-46]
16:40: Spatially-varying blur kernel measurement based on discrete cosine transform single-pixel imaging, Hongzhi Jiang, Yu Wang, Huilei Zhao, Xudong Li, Yang Xu, Yuxi Li, Yunfan Wang, Beihang Univ. (China) .............................. [11062-47]
17:00: Refractive telescope design with digital correction of residual chromatic aberrations, Jingang Zhang, Univ. of Chinese Academy of Sciences (China) and Chinese Academy of Sciences (China); Yunfeng Nie, Vrije Univ. Brussel (Belgium); Qiang Fu, King Abdullah Univ. of Science and Technology (Saudi Arabia); Yifan Peng, The Univ. of British Columbia (Canada); Shuzhen Wang, Xidian Univ. (China) .............................. [11062-48]
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1. The onsite AV management is handled by Neumann & Müller, the local AV agency tasked by Messe München GmbH. Speakers have been contacted by this agency and are asked to follow the guidelines received by Neumann & Müller.

2. Preview your presentation onsite
   All presenters are strongly encouraged to visit Speaker Check-In at least 2 hours prior to their presentation to preview their files through the SPIE presentation system, or the day before if presenting in first morning session).
GENERAL INFORMATION

Author / Presenter Information

Speaker Check-In and Preview Station
ICM, First Floor Foyer, and Hall A1
Monday through Thursday · Open during registration hours

All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are requested to come to Speaker Check-In (their conference room during the breaks) with their memory devices or laptops to confirm their presentation display settings. The local AV supplier M-Events will assist you. As stated in the author submission guidelines, please note that SPIE will be recording audio and slide content.

SPIE Optical Metrology and SPIE Digital Optical Technologies Joint Poster Sessions
Tuesday - Thursday 25 - 27 June 2019 · 12:00 - 12:40
Location: ICM, Hall B0

All symposium attendees are invited to attend Digital Optical Technologies and Optical Metrology Joint Poster Sessions provided as an opportunity to enjoy networking while reviewing poster papers.

Please note that the Digital Optical Technologies Conference Poster Session (Conf. 10335) has been scheduled as part of the Wednesday Poster Session 2, and will run from 12:50 to 13:50 hrs.

TUESDAY POSTER SESSION 1: Conf. 11056, 11058, 11060 (Optical Metrology)

WEDNESDAY POSTER SESSION 2: Conf. 11057, 11059 (Optical Metrology), 11062 (Digital Optical Technologies)

THURSDAY POSTER SESSION 3: Conf. 11061 (Optical Metrology)

Attendees are encouraged to review the high-quality papers and 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. Attendees are requested to wear their conference registration badges to the poster sessions.

Please see below for specific conference poster session timing.

Tuesday 25 June · Poster Session 1
Optical Metrology, Conf. 11056 (Opt. Measurement Systems-Industrial Inspection): 13:00 to 14:20
Optical Metrology, Conf. 11058 (Optics for Arts, Architecture, and Archaeology): 12:30 to 13:10

Wednesday 26 June · Poster Session 2
Digital Optical Technologies, Conf. 11062: 12:50 to 13:50
Optical Metrology, Conf. 11057 (Modeling Aspects in OM): 11:30 to 12:40
Optical Metrology, Conf. 11059 (Multimodal Sensing and Artificial Intelligence: Technologies and Applications): 11:30 to 12:40

Thursday 27 June · Poster Session 3
Optical Metrology, Conf. 11061 (Automated Visual Inspection and Machine Vision): 11:30 to 12:30

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. 11056, 11058, 11060
Setup—Monday, 13:00 hrs; Break-down—Tuesday, 17:00 hrs

Wednesday 28 June · Conf. 11057, 11059, 11062
Setup—Wednesday, 10:00 hrs; Break-down—Wednesday, 17:00 hrs

Thursday 29 June · Conf. 10334
Setup—Thursday, 9:30 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.

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 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 118
Browse the latest SPIE Press Books and proceedings.

Business Centre
ICM Foyer
Open during registration hours.
Services include copying, and printing options at cost.

SPIE Luggage + Coat Check
Foyer West, Level -1 · Open during registration hours
Luggage, package, and coat storage are available against charge. Please note opening hours.

Urgent Message Line
An urgent message line is available during registration hours: +44 29 2089 4747. Attendees should check the message board in the registration area for any messages held for them.
Food and Beverage Services

Coffee Breaks
ICM Foyers, and Hall A1
Complimentary coffee will be served twice daily at the times indicated in the programme. Check individual conference listings for exact times and locations.

Food and 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 in Entrance West. In good weather, a beer garden is operated in the courtyard between Halls A and C. There are also a number of bars and restaurants located in the surrounding hotels as well as the “Riem Arkaden” shopping centre on the other side of the underground station “Messestadt West”.

Car Rental
1. Call the Hertz International Reservation Center at 1-800-654-3001 in the USA or your local Hertz Reservations Center to receive a special discount for SPIE. Reservations may also be placed on-line at www.hertz.com. You will receive 15% off qualifying affordable rates at participating locations in Munich, Germany.
2. 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.
3. This special offer is available for rentals from June 15- July 7, 2019.

Digital Optical Technologies
Attendee Discount
15% OFF Qualifying Affordable Rates
PC#137480

Important Rental Information
1. The SPIE discount is available at participating locations in Munich, GE.
2. The 15% Discount applies to rentals on Affordable Rates from June 15- July 7, 2019.
3. Reservations must be made at least 24 hours prior to vehicle pickup, using the PC# on the coupon. No CDP discounts apply.
4. Minimum rental period is 3 days.
5. Offer includes Compact and above both manuals and automatic (includes basic/standard cars - not vans, premium, luxury, collections, etc.).
6. Discount does not apply to taxes, intercity drop charges, insurance or optional services.
7. Certificate has no cash value and may not be combined with any other offer, discount or promotion. Certificate must be presented and surrendered at time of rental.
8. Normal intercity rules and rate restrictions apply.
9. Minimum rental age is 25 (exceptions apply). Hertz standard driver and credit qualifications for the rental location apply. Blackout periods may apply.

Fight Bias, Embrace Diversity
SPIE seeks to cultivate a culture of openness and inclusivity. Help us eradicate bias and make the world of optics and photonics a shining example of all minds coming together to innovate regardless of gender, race, nationality, culture, educational background, politics, sexuality, body-type and age, for the betterment of life.
Educate yourself on the issues faced by a diverse workforce, challenge your own assumptions, and tap into the rich pool of talent, perspectives, and ideas offered by people different from you.
Proceedings

SPIE. OPTICAL METROLOGY

Paid conference registration includes online Proceedings of SPIE. In the tables below you will find product order numbers to use on the registration form.

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 may purchase additional online collections for $175 or additional online proceedings volumes for $60 each; add during registration or contact SPIE you may purchase print Proceedings of SPIE volumes for this conference from www.Proceedings.com.

**Accessing Online Proceedings**

To access your proceedings:

• Sign in to [http://spiedigitallibrary.org](http://spiedigitallibrary.org) or create an SPIE account using the email address you used to register for the conference.

• Go to My Account at the top of the page, to find your available conference proceedings volumes.

You can also access this content via your organization’s SPIE Digital Library account.

For assistance, contact SPIE:

**Email:** SPIEDLsupport@spie.org

**Phone (North America):** +1 888 902 0894

**Phone (Rest of World):** +1 360 685 5580

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**Online Proceedings Volumes**

Conference Attendees: The price for additional online proceedings volumes is noted above. Order during registration.

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<th>Product Order Number</th>
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<tr>
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<td>DL 11061</td>
<td>Automated Visual Inspection and Machine Vision III</td>
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**Online Proceedings Collections**

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54  SPIE Optical Metrology · spie.org/om  | SPIE Digital Optical Technologies · spie.org/dot
Proceedings

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<td>DL11062</td>
<td>Digital Optical Technologies 2019 Bernard C. Kress, Peter Schelkens</td>
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Acceptance of Policies and Registration Conditions

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

Attendee Registration and Admission Policy
SPIE, or their officially designated event management, in their sole discretion, reserves the right to accept or decline an individual’s registration for an event. Further, SPIE, or event management, reserves the right to prohibit entry or to remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, whose conduct is not in keeping with the character and purpose of the event. Without limiting the foregoing, SPIE and event management reserve the right to remove or refuse entry to anyone who has registered or gained access under false pretenses, provided false information, or for any other reason whatsoever that they deem is cause under the circumstances.

Payment Policy
Registrations must be fully paid before access to the conference is allowed. SPIE accepts VISA, MasterCard, American Express, Discover, Diner’s Club, checks and wire transfers. Onsite registrations can also be paid with cash.

SPIE Safe Meeting Policy | Code of Conduct
SPIE is committed to providing a harassment- and discrimination-free experience for everyone at our events, an experience that embraces the richness of diversity where participants may exchange ideas, learn, network, and socialize in the company of colleagues in an environment of mutual respect.

SPIE does not tolerate harassment of event participants, attendees, exhibitors, speakers, volunteers, contractors, service providers, venue staff, or SPIE staff. This Code of Conduct applies to all SPIE meeting-related events, including those sponsored by other organizations but held in conjunction with SPIE events, in public or private facilities.

The SPIE Anti-Harassment Policy may be found at http://spie.org/policy (PDF)
The SPIE Code of Conduct may be found at http://spie.org/conduct (PDF)
In addition, SPIE Members and authors of SPIE publications must adhere to the SPIE Code of Ethics, found at http://spie.org/ethics (PDF)

Reporting of Unethical or Inappropriate Behavior
Onsite at an SPIE meeting, contact any SPIE Staff with concerns or questions for thorough follow-up. If you feel in immediate danger, please dial the local emergency number for police intervention.

SPIE has established a confidential reporting system for staff and all meetings participants to raise concerns about possible unethical or inappropriate behavior within our community. Complaints may be filed by phoning toll-free to +1-888-818-6898 from within the United States and Canada, or online at www.SPIE.ethicspoint.com and may be made anonymously.

Identification Requirement Policy
To verify registered participants and provide a measure of security, SPIE will ask attendees to present a government-issued photo identification at registration to collect registration materials.

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

Access to Conference Events / Access for Children Younger than 18
All conference technical and networking events require a badge for admission. Registered attendees may bring children with them as long as they have been issued a badge. Registration badges for children under 18 are free and available at the SPIE registration desk onsite. Children under 14 years of age must be accompanied by an adult at all times, and guardians are asked to help maintain a professional, disturbance-free conference environment.

Exhibition Hall Access / Access for Children Younger than 18
Everyone who attends the exhibition must be registered and have a badge. Badges for children are free and available onsite at the registration desk. Children under 14 years of age must be accompanied by an adult at all times. Guardians are asked to help maintain a professional, disturbance-free exhibition environment. Children under 18 are not allowed in the exhibition area during exhibition move-in and move-out.

Unauthorized Solicitation Policy
Unauthorized solicitation in the Exhibition Hall is prohibited. Any nonexhibiting manufacturer or supplier observed to be distributing information or soliciting business in the aisles, or in another company’s booth, will be asked to leave immediately.

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

Exhibition Hall: Recordings of any kind are prohibited without prior written consent of the presenter or instructor. Attendees may not capture or use materials presented in any meeting/course room or in course notes on display without written permission. Consent forms are available at Speaker Check-In or SPIE Registration. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media. Refusal to comply with such requests is grounds for expulsion from the event.
Capture and Use of a Person’s Image

By registering for an SPIE event, you grant full permission to SPIE to capture, store, use, and/or reproduce your image or likeness by any audio and/or visual recording technique and create derivative works of these images and recordings in any SPIE media now known or later developed, for any legitimate SPIE marketing or promotional purpose. By registering for an SPIE event, you waive any right to inspect or approve the use of the images or recordings or of any written copy. You also waive any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials. By registering, you release, defend, indemnify and hold harmless SPIE from and against any claims, damages or liability arising from or related to the use of the images, recordings or materials, including but not limited to claims of defamation, invasion of privacy, or rights of publicity or copyright infringement, or any misuse, distortion, blurring, alteration, optical illusion or use in composite form that may occur or be produced in taking, processing, reduction or production of the finished product, its publication or distribution.

Laser Pointer Safety Information/Policy

SPIE supplies tested and safety-approved laser pointers for all conference meeting rooms. For safety reasons, SPIE requests that presenters use provided laser pointers. Use of a personal laser pointer represents the user’s acceptance of liability for use of a non-SPIE-supplied laser pointer. If you choose to use your own laser pointer, it must be tested to ensure <5 mW power output. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Waivers are available at Speaker Check-In.

Unsecured Items Policy

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

Wireless Internet Service Policy

At most events, SPIE provides wireless access for attendees. Properly secure your computer before accessing the public wireless network. SPIE is not responsible for computer viruses or other computer damage.

No-Smoking Policy

Smoking, including e-cigarettes, is not permitted at any SPIE event.

Agreement to Hold Harmless

Attendee agrees to release and hold harmless SPIE from any and all claims, demands, and causes of action arising out of or relating to your participation in the event you are registering to participate in and use of any associated facilities or hotels.

Event Cancellation Policy

If for some unforeseen reason SPIE should have to cancel an event, processed registration fees will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.
Mark your Calendar

Optical Metrology

and

Digital Optical Technologies

2021

21–24 June 2021
Internationales Congress Center, Munich, Germany