Plan to Attend

DIGITAL OPTICAL TECHNOLOGIES

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

25–29 June 2017
Internationales Congress Center
Munich, Germany

Co-located with
SPIE OPTICAL METROLOGY

www.spie.org/dot17programme

- Novel optics for Augmented, Mixed and Virtual Reality Systems
- Computational optics
- Digital optics for image formation
- Switchable, tunable and digitally reconfigurable optics
- Digital optics for sensing
- Integrated digital photonics
- NEW COURSES OFFERED: 25 June

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

WORLD OF PHOTONICS CONGRESS

www.photonics-congress.com
JOIN US IN MUNICH!

Attend SPIE Digital Optical Technologies—a new conference dedicated to emerging digital trends and perspectives in optics. Come to Munich to meet with users and researchers to discuss the latest developments in the field of digital optics. The symposium will highlight all digital aspects from design, fabrication, to integration in systems and final functionality, such as:

a) **Design**: numerical algorithms to help design novel optics from macroscopic (freeform optics) to nanoscopic scales (metamaterials, plasmonics,...).

b) **Fabrication**: novel digital lithography and freeform mold diamond turning techniques and technologies.

c) **Functionality**: computational techniques to enhance functionality in imaging and display. Digital switching, tuning and reconfiguring to alter optics functionality dynamically.

Colocated with Laser 2017 in Munich, Germany, this new symposium aims at combining all three aspects of digital optics around the following topics:

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

These are emerging today as very hot topics in academia, research institutions and industry, as well as in the venture capital community. Researchers, engineers, managers, industry leaders as well as market analysts are welcome to share their knowledge and experience, and be part of the ongoing digital optics revolution.

Come and experience first-hand hot new consumer products demoed throughout the Symposium, such as Mixed Reality (Microsoft Hololens) and Virtual Reality (Oculus and HTC Vive) headsets.

Learn about recent advances in using digital technologies to enhance the performance of optical imaging and display. Find out about new approaches that push digital principles at the macro-, micro- and nanoscales to the forefront of optics. Exchange new ideas, address your shared concerns, and get access to information not yet published in the mentioned topical areas.

Share your research with other engineers, scientists, researchers, and managers.

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

**2017 Symposium Chairs**

- **Bernard C. Kress**, Microsoft Corp. (United States)
- **Wolfgang Osten**, Univ. Stuttgart (Germany)
- **H. Paul Urbach**, Technische Univ. Delft (Netherlands)
### DAILY EVENT SCHEDULE

<table>
<thead>
<tr>
<th>Sunday 25 June</th>
<th>Monday 26 June</th>
<th>Tuesday 27 June</th>
<th>Wednesday 28 June</th>
<th>Thursday 29 June</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COURSES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1216</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1218</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1217</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1219</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPECIAL EVENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop: Making the Most of your Presentation (Dumont) 8:30 to 12:30, p. 5</td>
<td>Workshop: Conveying Messages with Graphs (Dumont), 8:30 to 12:30, p. 5</td>
<td>Hands-On Demo Session, 10:00 to 16:00, p. 3</td>
<td>Hands-On Demo Session, 10:00 to 16:00, p. 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Conf. 10335 Digital Optical Technologies (Kress, Osten, Uhrbach), 9–11</td>
</tr>
</tbody>
</table>

### SPIE PLENARY SESSION

**Wednesday 28 June 2017 · 10:30 to 10:40**

**WELCOME AND INTRODUCTION**

10:40 to 11:25:

**ENGINEERED OPTICAL FUNCTIONALITIES THROUGH FLAT METASURFACES**

**Federico Capasso**, Robert L. Wallace Professor of Applied Physics and Vinton Hayes Senior Research Fellow in Electrical Engineering, Harvard Univ., (USA)

Composed of nanostructures designed and arranged in specific patterns, ultrathin optical metasurfaces are able to alter every single aspect of transmitting or reflecting light beams. Their basic operation principle is related to the collective scattering of light by an ensemble of sub-wavelength optical elements (such as optical antennas, resonators, etc.). Based on this concept, metasurfaces with highly custom optical functionalities can address today’s stringent industry requirements in fields such as imaging, display, sensing and metrology, which could not have been effectively addressed otherwise by using traditional optical elements such as refractive, reflective, diffractive or holographic elements.

**Biography:** Federico Capasso is the Robert Wallace Professor of Applied Physics and Vinton Hayes Senior Research Fellow in Electrical Engineering, Harvard School of Engineering and Applied Science, Cambridge, Massachusetts, since 2003, and formerly Adjunct Researcher at the Institute for Quantum Studies at the Texas A&M University. Professor Capasso’s research cuts across several disciplines in basic physics, applied physics and engineering, which include optics, semiconductor physics, mesoscopic physics, solid-state electronics, optoelectronics and micromechanics. This multi-faceted research led Capasso and his collaborators to invent the quantum cascade (QC) laser. In another research direction Capasso’s group is also exploring new mid-infrared light sources based on surface plasmon and on the enhanced transmission of light through a periodic array of subwavelength holes. Another area of Capasso’s research is the investigation of quantum electrodynamical phenomena such as the Casimir effect (the attractive force between uncharged parallel metallic plates. His honours include membership in the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Sciences, the Academia Europaea and honorary membership in the Franklin Institute. He is a recipient of the IEEE Edison Medal, the American Physical Society Arthur Schawlow Prize in Laser Science, the International King Faisal Prize for Science, the SPIE Gold Medal, the American Academy of Arts and Sciences Rumford Prize, the American Association for the Advancement of Science Newcomb Cleveland Prize, the IEEE Sarnoff Award, the Materials Research Society Medal, the Franklin Institute Wetherill Medal, the European Physical Society Quantum Electronics Prize, the Rank Prize in Optoelectronics, the Optical Society Wood Prize, the Berthold Leibinger Future Prize, the Julius Springer Prize in Applied Physics, the Institute of Physics Duddell Medal, the Jan Czochralski Award for lifetime achievements in Materials Science, and the Gold Medal of the President of Italy for meritorious achievement in science.

**World of Photonics Congress-wide Plenary Session**

**Monday 26 June 2017 · 10:00 to 11:00**

**PUTTING A SPIN ON PHOTONS**

**Jörg Wrachtrup**, Univ. of Stuttgart (Germany)

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

**Prof. Dr. Jörg Wrachtrup**, who is the head of the 3rd Institute of Physics at the University of Stuttgart, received the first ever Zeiss Research Award this year. He received the Gottfried Wilhelm Leibniz Award for his research work in 2011 and the Max Planck Research Award in 2014.
Augmented Reality / Virtual Reality Hands-On Demo Sessions

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

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

FOUR SYSTEMS TO CHOOSE FROM:
- Microsoft HoloLens Mixed Reality Untethered headset
- Oculus Rift CV1 VR Headset with Hand Controllers
- HTC Vive VR headset with hand controllers
- Sony PlayStation VR Headset with Hand Controllers

The demo sessions are private and last for 20 min, (5 min tutorial followed by 15 min demo). One device per session (please choose your device). If you want to try out multiple devices, you need to book multiple sessions.

DEMO SESSION TIMES:
- Monday 26 June 2017 · 14:00 to 16:00
- Tuesday 27 June 2017 · 10:00 to 16:00
- Wednesday 28 June 2017 · 10:00 to 16:00

SIGN-UP ONLINE BY ADDING THIS FREE DEMO TO YOUR REGISTRATION
Space will go quickly!

Looking for more in-depth learning? Check out our COURSE offerings on pages 6–8.
Student and Professional Development Events

Student Chapter Leadership Workshop
Saturday 24 June 2017 · 9:00 to 17:00
Open to SPIE Student Chapter members
SPIE’s successful Student Chapter Leadership Workshop is back in Europe! During this highly interactive, all-day event facilitated by Dr. Jean-luc Doumont, you will discuss what being a leader is all about (and what it is not about), how to persuade others, and how to go from ideas to achievements for your chapter. Join Student Chapter officers from around the world for a full day of professional development training and networking.

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

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

Career Choices Panel Discussion
Wednesday 28 June 2017 · 13:20 to 14:00
There are numerous critical career choices and decisions that face new graduates in optics and photonics. Academia or Industry? Staying in your current job, or making a career transition? This event will help you explore potential career pathways in the world of photonics and get solid advice on how you can translate your knowledge, abilities, and interests into meaningful work. Join our experienced panelists and have your questions answered in this wide-ranging discussion.

Panelists: TBA
Making the Most of Your Presentation
Sunday 25 June 2017 · 8:30 to 12:30
WS897
Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.
Oral presentation skills are a key to success for researchers and professionals alike. This course offers a no-nonsense approach to preparing and giving presentations, with a particular focus on structure, slides, and delivery. It also offers tips on how to manage the nervousness associated with speaking in public.
LEARNING OUTCOMES
This course will enable you to:
• organize your material into an effective structure
• create slides that get the message across
• deliver your presentation effectively, both verbally and nonverbally
INTENDED AUDIENCE
This course is intended for anyone who must prepare and give oral presentations about his or her research work. Both novice and experienced speakers can expect to gain a lot from it.
INSTRUCTOR
Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.
Note: This course is free to student technical attendees. No advance registration required.

Structuring your Research Paper
Sunday 25 June 2017 · 13:30 to 17:30
WS908
Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.
Strong writing skills are a key to success for researchers and professionals alike. This course discusses how to structure research papers, dissertations, and other reports effectively at all levels to get the readers’ attention, facilitate navigation, and thus get the message across optimally to their audiences.
LEARNING OUTCOMES
This course will enable you to:
• create an effective abstract, introduction, and conclusion
• organize your material into an accessible structure
• construct paragraphs that get the message across
INTENDED AUDIENCE
This course is intended for anyone who must write or edit technical documents in general and research papers in particular. Both novice and experienced authors can expect to gain a lot from it.
INSTRUCTOR
Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.
Note: This course is free to student technical attendees. No advance registration required.

Conveying Messages with Graphs
Monday 26 June 2017 · 8:30 to 12:30
WS1202
Course Level: Introductory
Course Length: Half-day (3.5 hours)
Continuing Education Units (CEU): 0.35 Only available upon request.
Widely used in research and development to analyze and communicate data, graphical displays are still poorly mastered by researchers (and popular software does not help). This course discusses how to create more effective graphs—graphs that are truly visual, are truthful to the data, and get the message across.
LEARNING OUTCOMES
This course will enable you to:
• select the right graph for a given data set and a given research question
• optimize this graph to make it intuitive and to reveal the data
• phrase a caption that gets the message across
INTENDED AUDIENCE
This course is intended for anyone who must create graphs for written documents or oral presentations. Both novice and experienced authors/speakers can expect to gain a lot from it.
INSTRUCTOR
Jean-luc Doumont runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.
Note: This course is free to student technical attendees. No advance registration required.
Digital Optical Technologies

Using Spatial Light Modulators

SC1216

Course Level: Introductory
CEU: 0.4 $300 Members | $355 Non-Members USD
Sunday 8:30 to 12:30

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

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

LEARNING OUTCOMES

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

INTENDED AUDIENCE

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

INSTRUCTOR

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

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

SC1217

Course Level: Intermediate
CEU: 0.4 $300 Members | $355 Non-Members USD
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.
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).

MONEY-BACK GUARANTEE

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

CONTINUING EDUCATION UNITS

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

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

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 deep 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 SC551
- Discuss current application fields and products using such optics, as in Augmented and Mixed Reality headsets, and high resolution hybrid incremental/absolute diffractive optical encoders

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

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

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

Course Level: Intermediate
CEU: 0.4 $300 Members | $355 Non-Members USD
Sunday: 8:30 to 12:30

The course starts by providing an extensive overview of the numerous optical technologies and architectures implemented in today’s wearable display consumer products such as in:
- Smart glasses and digital eyewear
- Augmented Reality (AR) and Mixed Reality (MR) headsets
- Virtual Reality (VR) and Merged Reality headsets

The course describes the optical backbone of such head worn systems, and the various optical sub-systems building blocks are listed and analyzed. They include:
- Depth mapping sensors (either though structured illumination or time of flight)
- Head tracking sensors (either IMU or camera based)
- Gaze tracking sensors
- Display engines including microdisplay panels, scanner based light engines and diffractive phase panels
- Optical combiners integrated either in free space or waveguide platforms

Emphasis is put on the design and fabrication techniques to provide the best immersion and comfort to the end user, along the following guidelines:
- Wearable comfort (size/weight, center of gravity)
- Visual comfort (eye box size and IPD coverage, resolution, field of view, distortion, dynamic range, stereo overlay amount)
- Vvergence / accommodation disparity (varifocal, multifocal, light fields and holographic displays)
- Foveated rendering and peripheral displays
- Pupil swim and active distortion compensation

The advantages and limitations of the various optical technologies addressing such specifications are reviewed and analyzed. More specifically, emphasis will be put on eyebox definition as an experienced spec, subsequent eyebox replication and eyebox enlargement techniques as well as alternative eyebox generation techniques.

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

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

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

LEARNING OUTCOMES
This course will enable you to:
- Explain the various consumer and enterprise head worn systems available in industry today, declined as smart glasses, digital eyewear, AR, MR and VR HMDs, and understand their fundamental differences and specifics.
- Explain the current optical technologies and sub-systems used in VR, AR and MR head worn systems, their advantages and limitations (such as depth mapping sensors, head tracking sensors, display engines, combiner optics, gaze trackers, ...).
LEARNING OUTCOMES
This course will enable you to:
- Explain the technological and economic forces that have led to the paradigm of computational imaging.
- Explain the role of joint electro-optical design merit function for unifying the design of such imaging systems.
- Explain the key role of noise and signal regularization in image estimation.
- Explain mathematics needed to design and characterize such systems, such as condition number of system matrices, mean-squared error merit functions, and L1 and L2 regularization.

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

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

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

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

Don't miss the Augmented Reality / Virtual Reality Hands-On Demo Sessions, see p. 3.
CONFERENCE 10335
Monday - Wednesday 26-28 June 2017 • Proceedings of SPIE Vol. 10335

Digital Optical Technologies

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

Programme Committee: Partha P. Banerjee, Univ. of Dayton (United States); Hans B. Bjelkhagen, Glyndwr Univ., Ctr. for Ultrarealistic Imaging (United Kingdom); Arie den Boef, ASML, Netherlands B.V. (Netherlands); Federico Capasso, Harvard School of Engineering and Applied Sciences (United States); Oliver Cassart, Northwestern Univ. (United States); Andreas Hammerschmidt, HOLOEYE Photonics AG (Germany); Yoshio Hayasaki, Utsunomiya Univ. (Japan); Hans Peter Herzig, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Hong Hua, College of Optical Sciences, The Univ. of Arizona (United States); Fu-Chung Huang, nVIDIA Corp. (United States); Bahram Javidi, Univ. of Connecticut (United States); Sabina Jeschke, RWTH Aachen Univ. (Germany); Dirk Kamgiesser, Seebright inc. (United States); Norbert Kerwien, Carl Zeiss AG (Germany); Byoungho Lee, Seoul National Univ. (Korea, Republic of); Scott McEldowney, Magic Leap, Inc. (United States); Juan C. Minano, Univ. Politecnica de Madrid/Ctr. for Virtual Reality CeDInt (Spain); Peter Wozniak, Dan S. Curticapean, Hochschule Offenburg (Germany); Nicolas Petrov, ITMO Univ. (Russian Federation); Karen O. Egiazarian, Tamper Univ. of Technology (Finland).

SESSION 1 ............................ MON 8:00 TO 9:50

Optical Architectures for Augmented, Mixed and Virtual Reality HMDs
Session Chairs: Juan C. Miñano, Limbak (Spain); Scott McEldowney, Oculus VR, LLC (United States); Bernard C. Kress, Microsoft Corp. (United States)

See-through 3D technology for augmented reality (Invited Paper), Byoungho Lee, Seoul National Univ. (Korea, Republic of)…………………………………………………………. [10335-1]

OLED microdisplays in near-to-eye applications: challenges and solutions, Uwe Vogel, Bernd Richter, Philipp Wartenberg, Peter König, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Olaf R. Hild, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Karsten Fehse, Matthias Schober, Elisabeth Bodenstein, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Beatrice Beyer, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany).……………………………………… [10335-2]

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

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

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

MONDAY 26 JUNE
WELCOME AND INTRODUCTION ............... 7:55 TO 8:00

SESSION 2 ............................... MON 11:20 TO 12:50

Computational Optics for Imaging and Sensing
Session Chairs: Pascal Picart, Univ. du Maine (France); Hans Peter Herzig, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

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

Computational wavelength resolution for in-line lensless holography: phase-coded diffraction patterns and wavefront group-sparsity, Vladimir Y. Katkovnik, Tampere Univ. of Technology (Finland); Igor A. Shevchenko, Nikolay V. Petrov, ITMO Univ. (Russian Federation); Karen O. Egiazarian, Tampere Univ. of Technology (Finland).…………………………………………………………………………………………. [10335-7]

Fast physical optics-based simulation of waveguide displays for mixed and virtual reality applications, Daniel Asouab, LightTrans International UG (Germany); David Grey, WaveOptics (United States); Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Adrian Travis, Microsoft Research (France); Reinhard Voelkel, SUSS MicroOptics SA (Switzerland).

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

SESSION 3 ............................... MON 14:00 TO 15:40

Imaging and Combiner Optics for HMDs I
Session Chairs: Bernard C. Kress, Microsoft Corp. (United States); Hong Hua, College of Optical Sciences, The Univ. of Arizona (United States)

The ideal imaging AR waveguide, David Cory, WaveOptics (United Kingdom).…………………………………………………………………………………………………………………………. [10335-10]

Thin combiner optics utilizing volume holographic optical elements (vHOEs) using Bayoflex® HX photopolymer film, Günther Waltze, Friedrich-Karl Bruder, Thomas Föcke, Christian Rewitz, Christel Manecke, Thomas Röllle, Enrico Orselli, Covestro AG (Germany).……………………………………………………………………………………………………………………………………………………………………………………………………. [10335-11]

Folded optics with birefringent reflective polarizers, Timothy Wong, 3M Co. (United States).……………………………………………………………………………………………………………………………………………………………………………………………………. [10335-12]

Subwavelength optics for new optical combiners: beyond diffraction optics’ limitations, Guillaume Basset, Giorgio Quaranta, Frédéric Zanella, Angélique Luu-Dinh, Ctr. Suisse d’Électronique et de Microtechnique SA (Switzerland).……………………………………………………………………………………………………………………………………………………………………………………………………. [10335-13]

Super-resolution optics for virtual reality, Dejan Grabovickic, Limbak (Spain); Pablo Benitez, Juan C. Minano, Limbak (Spain) and Univ. Politécnica de Madrid (Spain); Pablo Zanora, Marina Buljan, Bharathwaj A. Narasimhan, Limbak (Spain); Mihnea I. Nicolae, CeDInt-UPM (Spain); Jesús Lopez, Limbak (Spain); Eduardo Sanchez, CeDInt-UPM (Spain).……………………………………………………………………………………………………. [10335-14]
CONFERENCE 10335

SESSION 4 ............................... MON 16:10 TO 17:50
Imaging and Combiner Optics for HMDs II
Session Chairs: Ariè den Boef, ASMl Netherlands B.V. (Netherlands); H. Paul Urbach, Technische Univ. Delft (Netherlands)
Advanced freeform optics enabling ultra-compact VR headsets. Pablo Benitez, Juan C. Mitano, Limbak (Spain) and Univ. Politecnica de Madrid (Spain); Pablo Zamora, Dejan Grabovickic, Marina Buljan, Limbak (Spain); Milena I. Nikolov, Univ. Politecnica de Madrid (Spain); Bharathwaj A. Narasimhan, Jorge Gorospe, Jesus Lopez, Limbak (Spain); Eduardo Sanchez, Univ. Politecnica de Madrid (Spain). ........................................... 10335-16
High collimated coherent illumination for reconstruction of digitally calculated holograms: design and experimental realization. Alexander V. Morozov, Sergey Dubynin, German Dubinin, SAMSUNG R&D Institute Rus. (Russian Federation); Sun Il Kim, Chi-Sung Choi, Hoon Song, Hong-Seok Lee, Samsung Advanced Institute of Technology (Korea, Republic of); Andrey Putlin, P.N. Lebedev Physical Institute (Russian Federation); Sergey Kopenkin, Yuriy Borodin, Moscow State Technical Univ. of RadioTechnics, Electronics and Automation (Russian Federation); Igor Yaruisk, SAMSUNG R&D Institute Rus. (Russian Federation). ........................................... 10335-17
Human-centric optical design for next generation wide FOV AR HMDs. Bernard C. Kress, Microsoft Corp. (United States). ........................................... 10335-19

TUESDAY 27 JUNE

SESSION 5 .............................. TUE 8:00 TO 9:50
Metasurfaces for Imaging and Sensing
Session Chairs: Federico Capasso, Harvard School of Engineering and Applied Sciences (United States); Christophe Perez, Magic Leap, Inc. (United States); TBA (Invited Paper), Federico Capasso, Harvard School of Engineering and Applied Sciences (United States); Wei-Ting Chen, Capital Normal University, Beijing (China)
Design of nanophotonic devices using efficient, rigorous simulations based on finite element methods. Sven Burger, Martin Hammerschmidt, Frank Schmidt, JCMMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany); Lin Zischiedrich, JCMMwave GmbH (Germany). ........................................... 10335-20
Design of nanophotonic devices using efficient, rigorous simulations based on finite element methods. Sven Burger, Martin Hammerschmidt, Frank Schmidt, JCMMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany); Lin Zischiedrich, JCMMwave GmbH (Germany). ........................................... 10335-21
Digital metasurface for wavefront modulation. Yan Zhang, Capital Normal University, Beijing (China)
Design of nanophotonic devices using efficient, rigorous simulations based on finite element methods. Sven Burger, Martin Hammerschmidt, Frank Schmidt, JCMMwave GmbH (Germany) and Zuse Institute Berlin (ZIB) (Germany); Lin Zischiedrich, JCMMwave GmbH (Germany). ........................................... 10335-22
Short-wavelength infrared high resistive photocathode based on Chalcogenide glasses for OASLM applications. Asi Solodar, Matvey Kalbanov, Ibrahim Abdulahlim, Ben-Gurion University of the Negev (Israel);

SESSION 6 ............................... TUE 10:20 TO 12:30
Tunable, Switchable and Reconfigurable Optics
Session Chairs: Joshua D. Silver, Univ. of Oxford (United Kingdom); Pascal Picart, Univ. du Maine (France)
Self-refraction in HMDs through adjustable focus lenses (Invited Paper). Joshua D. Silver, Univ. of Oxford (United Kingdom). ........................................... 10335-23
Self-refraction in HMDs through adjustable focus lenses (Invited Paper). Joshua D. Silver, Univ. of Oxford (United Kingdom). ........................................... 10335-24
Self-refraction in HMDs through adjustable focus lenses (Invited Paper). Joshua D. Silver, Univ. of Oxford (United Kingdom). ........................................... 10335-25
A robust liquid crystal device with adjustable deflection and diffraction for multiple applications. Neal Weinstock, Solid Corp. (United States). ........................................... 10335-26
A high-resolution optical rangerfinder using tunable focus lenses and optical spatial pattern processing. Tariq Shamir Khan Khaja, Mohsin Ali Mazhar, Haris Khan Niazi, Syed Azeem Reza, Lahore University of Management Sciences (Pakistan)
A high-resolution optical rangerfinder using tunable focus lenses and optical spatial pattern processing. Tariq Shamir Khan Khaja, Mohsin Ali Mazhar, Haris Khan Niazi, Syed Azeem Reza, Lahore University of Management Sciences (Pakistan). ........................................... 10335-27
Arbitrary shaping of ultrafast Bessel beams with a phase-only spatial light modulator. Ismael Ouahnifi idrisi, FEMTO-ST (France); Remo Giust, Luc Froehly, FEMTO-ST (France); Maxime Jacquot, Luca Fufaro, FEMTO-ST (France); John M. Dudley, Francois Courvoisier, FEMTO-ST (France). ........................................... 10335-28
Calibration and digital correction of aberrations in combined optical systems with interchangeable parts. Thomas Milde, Cei Zeiss AG (Germany)
Adaptive digital stereo microscope to support 3D vision: optomechanical design and experimental validation. Carsten C. Reichert, Daniel Claus, Alois M. Herkommer, Institut fu r Technische Optik (Germany). ........................................... 10335-29
Adaptive digital stereo microscope to support 3D vision: optomechanical design and experimental validation. Carsten C. Reichert, Daniel Claus, Alois M. Herkommer, Institut fu r Technische Optik (Germany). ........................................... 10335-30
Adaptive digital stereo microscope to support 3D vision: optomechanical design and experimental validation. Carsten C. Reichert, Daniel Claus, Alois M. Herkommer, Institut fu r Technische Optik (Germany). ........................................... 10335-31
Lunch Break .................................. Tue 12:30 to 13:40

SESSION 7 .................................. TUE 13:40 TO 15:30
Computer-generated Holography
Session Chairs: Hans J. Bjelkhagen, Glyndwr Univ. (United Kingdom); Adrian Travis, Microsoft Corp. (United States)
Large holographic 3D display for real-time computer-generated holography (Invited Paper). Ralf Häußler, Norbert Leister, Hagen Stolle, SeeReal Technologies GmbH (Germany). ........................................... 10335-32
Noniterative diffraction imaging method using partially coherent illumination. Yifeng Shao, Technische Univ. Delft (Netherlands); Chengliang Zhao, Soochow Univ. (China); Hendrik P. Urbach, Technische Univ. Delft (Netherlands). ........................................... 10335-33
An optical method for compensating phase discontinuity in a 360-degree viewable tabletop digital holographic display system. Yangjun Lin, Keenhoon Hong, Hayan Kim, Hyon-Gon Choo, Jin-Woong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of). ........................................... 10335-34
3D color reconstructions in single DMD holographic display with LED source and complex coding scheme. Maksymilian Chlipala, Tomasz Koziak, Warsaw Univ. of Technology (Poland). ........................................... 10335-35

SESSION 8 .................................. TUE 16:00 TO 17:50
Novel 3D Display Techniques and Technologies
Session Chairs: Thomas P. Fäcke, Covestro AG (Germany); Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland)
The promises and pitfalls of real-time holographic display (Invited Paper). Joel S. Kollin, Andrew Maimone, Microsoft Corp. (United States); Andreas G. Georgiou, Robinson College (United Kingdom). ........................................... 10335-36
VR versus LF. Tibor Bályogh, Holografika Kft. (Hungary). ........................................... 10335-37
Volumetric graphics in liquid using holographic femtosecond laser pulse excitations. Yoshio Hayashi, Tokyo University of Science (Japan). ........................................... 10335-38
Distortion-free 3D imaging using wavefront shaping. Martin Teich, Jeremy Sturm, Lars Büttner, Jürgen W. Czarske, TU Dresden (Germany). ........................................... 10335-39
Autostereoscopic image creation by hyperview matrix controlled single pixel rendering. Armin Granisic, FernUniv. in Hagen (Germany). ........................................... 10335-40

WEDNESDAY 28 JUNE

SESSION 9 ............................. WED 8:10 TO 9:50
Digital Optics for Structured Illumination
Session Chairs: Andreas Herrmschmidt, HOLOEYE Photonics AG (Germany); Pascal Picart, Univ. du Maine (France)
Smart spin-orbit photons using liquid crystals. Etienne Brasselet, Univ. Bordeaux (France). ........................................... 10335-41
Holographically generated structured illumination for cell stimulation in optogenetics. Felix Schmieder, Lars Büttner, Jürgen W. Czarske, TU Dresden (Germany); Maria Lelani Torres, Leibniz Univ. Hannover (Germany); Alexander Heisterkamp, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Simon Klapper, Volker Busskamp, DFG-Ctr. for Regenerative Therapies Dresden (Germany). ........................................... 10335-42
Design and quality metrics of point patterns for coded structured light illumination with diffractive optical elements in optical 3D sensors. Ralf Vandenhouwen, Technische Hochschule Wildau (Germany); Andreas Herrmschmidt, HOLOEYE Photonics AG (Germany). ........................................... 10335-43
Structured illumination 3D microscopy using adaptive lenses and multimode fibers. Jürgen W. Czarske, Katrin Philipp, Nektarios Koukorakis, TU Dresden (Germany). ........................................... 10335-44
Imaging and pattern projection through multicore fibers using the memory effect. Nicolino Stasio, Donald B. Conkey, Christophe Moser, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland). ........................................... 10335-45
PLENARY SESSION ........................ WED 10:30 TO 11:25
Optical Metrology/Digital Optical Technologies
Engineered Optical Functionalities through Flat Measurements
Federico Capasso, Harvard Univ. (United States)
For details, please see page 5-6 in the printed programme or visit http://www.spie.org/conferences-and-exhibitions/optical-metrology/special-events

POSTER SESSION ..................... WED 12:40 TO 13:50
Posters
Conference attendees are invited to attend the Optical Metrology Poster Session 2 on Wednesday. Come view the posters and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Posters will be available for viewing starting at 12:40 through 13:50 hrs on Wednesday. Poster authors, view poster presentation guidelines and set-up instructions on page 6, and at http://spie.org/p513.xml.

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

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

Compensation of distortion and perspective distortion of the projection lens, Anastasiia Burtseva, Kseniia V. Ezhova, ITMO Univ. (Russian Federation). (10335-57)

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


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

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

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

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

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

Power estimation of martial arts movement using 3D motion capture camera, Mohamad Zubir Mat Jafari, Nurzaiid Azraai, Ahmad Afiq Sabji Awang Soh, Univ. Sains Malaysia (Malaysia). (10335-65)

Development of an optical radar for distance learning cревires Mars, Leonid Smirnov, Victoria A. Popova, Ivan Popov, ITMO Univ. (Russian Federation). (10335-66)

Measuring the volume of brain tumour and determining its location in T2-weighted MRI images using hidden Markov random field: expectation maximization algorithm, Mohammad Faiq Mat Jafari, Univ. Sains Malaysia (Malaysia); Hayder Saab Abdulaqib, Univ. Sains Malaysia (Malaysia) and College of Education Al-Qadisiya (Iraq); Kussay N. Mutter, Ahmad Fairuz Omar, Univ. Sains Malaysia (Malaysia). (10335-67)

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

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

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

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

Optical power transmission in a polygon mirror-based optical coherene tomography system, Mike Everson, Univ. of Kent (United Kingdom). (10335-72)

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

Medical photoacoustic beamforming using minimum variance-based delay multiply and sum, Moein Mozaffarzadeh, Ali Mahdiqjaf, Mahdi Gooji, Tarbiet Modares UUniv. (Iran, Islamic Republic of). (10335-74)

An adaptive weighted Lp metric for optimal margin classification: a theoretical framework for optical remote sensing data, Sawon Pratihar, Indian Institute of Technology Kanpur (India). (10335-75)

Statistical classifiers on multivariate parameters for optical diagnosis of cervical cancer, Sabyasachi Mukhopadhyay, IISER Kolkata, India (India); Aisna Pradhan, IIT Kanpur (India); Nirmalya Ghosh, Prasanta K. Panigrahi, IISER Kolkata (India). (10335-76)

Light field reconstruction from external spiral mask camera by iterative method, Chang Liu, Peking University (China). (10335-77)

SESSION 10 ........................... WED 13:50 TO 15:30
Digital Optics for Sensing and Metrology
Session Chairs: Yoshiho Hayasaki, Utsunomiya Univ. (Japan); Byounghee Lo, Seoul National Univ. (Korea, Republic of)

High-resolution LCOS microdisplay with sub-kHz frame rate for high performance, high precision 3D sensor, Grzegorz Lazarew, Stefanie Bonffer, Philip Engel, HOLOEYE Photonics AG (Germany); Daniel Höhne, Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany). (10335-55)

Sinusoids-assisted empirical mode decomposition profilometry, Chenxing Wang, Feipeng Da, Southeast Univ. (China). (10335-46)

Phase unwrapping in fast fringe projection profilometry, Haixia Wang, Xicheng Yang, Zhejiang Univ. of Technology (China). (10335-47)

Feature selection from hyperspectral imaging for guava fruit defects detection, Mohamad Zubir Mat Jafari, Sou Ching Tan, Univ. Sains Malaysia (Malaysia). (10335-48)

Hyperspectral photoelasticity, Anand K. Asundi, Achyut Adhikari, Nanyang Technological Univ. (Singapore). (10335-49)

SESSION 11 ......................... WED 16:00 TO 17:40
Digital Holography for Sensing and Imaging
Session Chairs: Dirk Kannoijss, Seebright inc (United States); Norbert Kerwien, Carl Zeiss AG (Germany)

Sub-mm single-shot depth resolved digital holography, Joseph van Rooij, Jeroen Kalkman, Technische Univ. Delft (Netherlands). (10335-50)

Optical sound wave recording by digital holography with heterodyne technique, Osamu Matoba, Xiangyu Guan, Sudheesh K. Rajput, Kouchi Nitta, Kobe Univ. (Japan); Yasuhiro Awaitsui, Kyoto Institute of Technology (Japan). (10335-52)

Spectrally resolved digital holography using a white light LED, Daniel Claus, Giancarlo Pedrini, Wolfgang Osten, Univ. Stuttgart (Germany). (10335-53)

Psychographic phase retrieval by applying hybrid input-output (HIO) iterations sequentially, Sander Koenijgen, Technische Univ. Delft (Netherlands); Wim Coene, ASML Netherlands B.V. (Netherlands); Silvania Pereira, Hendrik P. Urbach, Technische Univ. Delft (Netherlands). (10335-54)

Imaging particles in full 3D parallax mode with two-wavelength off-axis Fresnel holography, Pascual Picart, Univ. de Maine (France); Soumaya Kara-Mechouar, Univ. de Maine (France) and Univ. du Maine; Ghebati, Abdou de Sétif (Algeria); Larbi B. Bouamama, Univ. Ferhat Abbas de Sétif. (Algeria). (10335-55)

Closing Remarks .......................... 17:40 TO 17:50

CONFERENCE 10335
Present and publish with SPIE.
When you share your research at an SPIE conference and publish in the SPIE Digital Library, you are opening up opportunities for networking, collaborating, and promoting your work. Proceedings of SPIE are covered by major scientific indexes and search services, including Web of Science, Scopus, Inspec, EI Compendex, Astrophysical Data Service (ADS), CrossRef, and Google Scholar.

SPIE Proceedings
www.spie.org/proceedings

YOUR RESOURCE. YOUR SOCIETY.
Join or Renew your SPIE Membership
Enhance your network · Take charge of your career · Broaden your knowledge

SPIE is the international society for optics & photonics.

www.spie.org/membership · help@spie.org · +1 360 676 3290
Registration

Onsite Registration and Badge Pick-up Hours
Sunday 25 June 2017 · COURSE registration: 7:45 hrs.
Conference registration: 10:00 to 17:00 hrs.
Monday 26 June 2017 · 7:30 to 17:00 hrs.
Tuesday 27 June 2017 · 8:00 to 17:00 hrs.
Wednesday 28 June 2017 · 8:30 to 17:00 hrs.
Thursday 29 June 2017 · 8:30 to 16:00 hrs.

Courses
Sunday 25 June 2017 · Opens 7:45 hrs.

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

Early Registration Pricing and Dates
Conference registration prices increase by €85 after 1/6/2017. The online form will automatically display the increased prices.

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

Press Registration
For credentialed press and media representatives only. Please email contact information, title, and organization to media@spie.org.

SPIE Cashier
Open during registration hours

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

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

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

Refund Information
There is a €50 service charge for processing refunds. Requests for refunds must be received by 14 June 2017; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions, or Special Events purchased are not refundable.

U.S. Government Credit Cards
U.S. Government credit card users: have your purchasing officer contact the credit card company and get prior authorization before attempting to register. Advise your purchasing agent that SPIE is considered a 5968 company for authorization purposes.

Author / Presenter Information

Speaker Check-In and Preview Station
Monday through Thursday · Open during registration hours
All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are asked to upload their presentations in Hall BO, where M-Events will be available to help with any questions during registration hours.

Poster Setup Instructions

DIGITAL OPTICAL TECHNOLOGIES AND OPTICAL METROLOGY JOINT POSTER SESSIONS
Wednesday 28 June · 12:40 to 13:50
Please see Optical Metrology conference programmes for specific poster session timing.
All symposium attendees are invited to attend Digital Optical Technologies poster sessions provided as an opportunity to enjoy networking while reviewing poster papers. Attendees are encouraged to review the high-quality papers that are presented in this alternate format and to interact with the poster authors. Poster authors must be present at their posters at the Poster Session times designated for their conference to answer questions and interact with the poster session audience.
Set up and removal times for each of the Poster Session days.
Wednesday 28 June
Setup—Wednesday, 10:00 hrs
Break-down—Thursday, 16:30 hrs
Poster presenters may post their poster papers starting at the announced times for each conference, and present them during their respective conference Poster Session. Any papers left on the boards following the poster removal time will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of the Poster Session. Poster authors should be at their papers during their assigned times to answer questions from attendees. For specific Poster Session times, please see the individual conference programs. Attendees are requested to wear their conference registration badges to the poster sessions.
GENERAL INFORMATION

Onsite Services

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

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

SPIE Publications
Browse the latest SPIE Press Books and proceedings.

Urgent Message Line
Messages for attendees can be left by calling a number to be held onsite at registration. Attendees should check the message board in the registration area for any messages held for them.

The Business Centre
Open during registration hours.
Use this service to print your boarding pass at a charge.

Food and Beverage Services

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

Food & Refreshments for Purchase
The ICM has three permanent food-service operations in the foyer area – the ICM Bistro, ICM Bar, and ICM Café where guests can purchase food. There is also the “Am See” restaurant, located on the 1st floor above the registration area of the ICM. Lunch at the Novotel is also available to those who are not staying at the hotel.
There are also a number of bars and restaurants located in the “Riem Arkaden” shopping centre on the other side of the underground station for the ICM, “Messestadt West”.

Hotels
For information about hotel bookings, please use the World of Photonics hotel booking service.

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

Airport Information
At Munich Airport, you’ll enjoy excellent national, inter-European and international flights. Its 106 airlines, 73 direct flights and 244 destinations make Munich an attractive destination. Find all current flight routes along with detailed information about the Munich Airport at their website. The Franz Josef Strauss Airport (MUC) is located 17 miles (27 km) northeast of the center of Munich.

Transportation from the Airport
Cross-Country Bus Transport; Shuttles, Public Transportation, How to reach the Internationales Congress Center Munich; and Driving Directions and Parking. Visit the Optical Metrology website for more information.

Car Rental
Call the Hertz International Reservation Center at 1-800-654-3001 in the USA or your local Hertz Reservations Center to receive a special discount for SPIE. Reservations may also be placed on-line at www.hertz.com. You will receive 15% off qualifying affordable rates at participating locations in Munich, Germany.
Be sure to identify yourself as a SPIE attendee. The PC# below must be on your advance reservation to receive this special offer. You must present this coupon at the time of rental in order to receive this discount.
This special offer is available for rentals from June 15- July 15, 2017.

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

Important Rental Information
The SPIE discount is available at participating locations in Munich, GE. The 15% Discount applies to rentals on Affordable Rates from June 15- July 15, 2017.
Reservations must be made at least 24 hours prior to vehicle pickup, using the PC# on the coupon. No CDP discounts apply.
Minimum rental period is 3 days.
Offer includes Compact and above both manuals and automatic (includes basic/standard cars - not vans, premium, luxury, collections, etc.). Discount does not apply to taxes, intercity drop charges, insurance or optional services.
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.
Normal intercity rules and rate restrictions apply.
Minimum rental age is 25 (exceptions apply). Hertz standard driver and credit qualifications for the rental location apply. Blackout periods may apply.
Proceedings.

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.

### Accessing Online Proceedings

To access your proceedings:

- Go to [http://spiedigitallibrary.org](http://spiedigitallibrary.org) and sign in. If you do not have an SPIE account, create one using the email address you used to register for the conference.
- Click the My Account link at the top of the page, then find the My Conference Proceedings tab, which will show your available proceedings volumes.

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

For assistance, contact SPIE:

- **Email:** SPIEDLsupport@spie.org
- **Phone (North America):** +1 888 902 0894
- **Phone (Rest of World):** +1 360 685 5580

### Online Proceedings Volumes

**Conference Attendees:** Print conference proceedings volumes are also available; see pricing below.

<table>
<thead>
<tr>
<th>Product Order Number</th>
<th>Volume Title/Volume Editors</th>
<th>Price for separate purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Print Volume</td>
<td>Online Volume</td>
<td>Meeting Attendees</td>
</tr>
<tr>
<td>10335 DL 10335</td>
<td>Digital Optical Technologies 2017 Bernard C. Kress, Wolfgang Osten, H. Paul Urbach</td>
<td>€95.00</td>
</tr>
</tbody>
</table>
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.

Granting Attendee Registration and Admission
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 remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, who in their sole opinion are not, or 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 any attendee, exhibitor, representative, or vendor 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.

SPIE Safe Meeting and Misconduct Policy
SPIE is a professional, not-for-profit society committed to providing valuable and safe conference and exhibition experiences. SPIE is dedicated to equal opportunity and treatment for all its members, meeting attendees, staff, and contractors. Attendees are expected to be respectful to other attendees, SPIE staff, and contractors. Harassment and other misconduct will not be tolerated; violators will be addressed promptly and seriously. Consequences up to and including expulsion from the event as appropriate will be implemented immediately.

The SPIE anti-harassment policy can be found at http://spie.org/policy.

Reporting of Unethical or Inappropriate Behavior
SPIE is an organization with strong values of responsibility and integrity. Our Harassment Policy, Ethics Statement, and Code of Professional Conduct contain general guidelines for behavior and for conducting business with the highest standards of ethics.

Onsite at a SPIE meeting, contact any SPIE Staff member with concerns or questions for thorough follow-up. If you feel in immediate danger, please dial 911 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 phone at +1-888-818-6898 or at www.SPIE.ethicspoint.com and, if preferred, may be made anonymously.

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

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

Access to Technical and Networking Events
All technical and networking events require a conference badge for admission. Registered attendees may bring their children with them as long as everyone is badged. 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 Policy
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. For safety and insurance reasons, children under 18 are not allowed in the exhibition area during exhibition move-in and move-out.

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

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

• An author or coauthor (including keynote, invited, and solicited speakers) will register at the author registration rate, attend the meeting, and make the presentation as scheduled.

• A manuscript (minimum 6 pages, maximum 20 pages) for any accepted oral, invited, keynote, or poster presentation will be submitted for publication in the Proceedings of SPIE in the SPIE Digital Library. Some SPIE events have other requirements that the author is made aware of at the time of submission.

• Only papers presented at the conference and received according to publication guidelines and timelines will be published in the Proceedings of SPIE in the SPIE Digital Library (or via the requirements of that event).

Audio, Video, Digital 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 the materials presented in any meeting/course room or in course notes on display without written permission. Consent forms are available at Speaker Check-in. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media.

EXHIBITION HALL: For security and courtesy reasons, recordings of any kind are prohibited unless one has explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall.
SPIE EVENT POLICIES

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

By registering for an SPIE event, I waive any right to inspect or approve the use of the images or recordings or of any written copy. I also waive any right to royalties or other compensation arising from or related to the use of the images, recordings, or materials. By registering, I 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 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 IIa (<5mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. Come to Speaker Check-in and test your laser pointer on our power meter. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Misuse of any laser pointer can lead to eye damage.

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

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

Wireless Internet Service Policy
At SPIE events where wireless is included with your registration, SPIE provides wireless access for attendees during the conference and exhibition but cannot guarantee full coverage in all locations, all of the time. Please be respectful of your time and usage so that all attendees are able to access the internet.

Excessive usage (e.g., streaming video, gaming, multiple devices) reduces bandwidth and increases cost for all attendees. No routers may be attached to the network. Properly secure your computer before accessing the public wireless network. Failure to do so may allow unauthorized access to your laptop as well as potentially introduce viruses to your computer and/or presentation. SPIE is not responsible for computer viruses or other computer damage.

Mobile Phones and Related Devices Policy
Mobile phones, tablets, laptops, pagers, and any similar electronic devices should be silenced during conference sessions. Please exit the conference room before answering or beginning a phone conversation.

Smoking
For the health and consideration of all attendees, smoking, including e-cigarettes, is not permitted at any event elements, such as but not limited to: plenaries, conferences, workshops, courses, poster sessions, hosted meal functions, receptions, and in the exhibit hall. Most facilities also prohibit smoking and e-cigarettes in all or specific areas. Attendees should obey any signs preventing or authorizing smoking in specified locations.

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
If for some unforeseen reason SPIE should have to cancel the event, registration fees processed will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.
Plan to attend
Photonics Europe
2018

The Premier European Optics and Photonics R&D Conference

Mark your calendar for 23–26 April 2018