

Applied Industrial Optics (AIO)

OSA Optics and Photonics Meeting

08 - 10 July 2019

OSA Headquarters

2010 Massachusetts Ave NW

Washington, DC USA

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Thank you to all the Committee Members for contributing many hours to maintain the high technical quality standards of OSA meetings.

General Information

Congress Wireless Internet

OSA is pleased to offer complimentary wireless internet services throughout the meeting space at OSA for all attendees.

Network SSID: **2010MassGuest**

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Registration

Lobby

Monday, 8 July	08:00—17:00
Tuesday, 9 July	07:30—17:00
Wednesday, 10 July	07:30—17:00

Hosted Meals and Networking Coffee Breaks

Pre-function Space

Monday, 8 July	08:00—09:00	Hosted Breakfast	
	10:00 – 10:30	Networking Coffee Break	
	12:30 – 14:00	Hosted Lunch	
	16:00 – 16:30	Networking Coffee Break	
	Tuesday, 9 July	07:30—08:30	Hosted Breakfast
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	12:30 – 14:30	Hosted Lunch	
	16:00 – 16:30	Networking Coffee Break	
	17:30—19:00	Closing Reception	

About OSA Publishing’s Digital Library

About OSA Publishing’s Digital Library Registrants and current subscribers can access all of the meeting papers on OSA Publishing’s Digital Library. The OSA Publishing’s Digital Library is a cutting-edge repository that contains OSA Publishing’s content, including 16 flagship, partnered and co-published peer reviewed journals and 1 magazine. With more than 304,000 articles including papers from over 640 conferences, OSA Publishing’s Digital Library is the largest peer-reviewed collection of optics and photonics.

Online Access to the Technical Digest

Full Technical Attendees have both early and free continuous access to the digest papers through OSA Publishing’s Digital Library. To access the papers go to osa.org/AIO and select the “Access digest papers” essential link on the right hand navigation. As access is limited to Full Technical Congress Attendees only, you will be asked to validate your credentials by entering the same login email address and password provided during the Congress registration process.

If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.

Gender-neutral Restroom

The Optical Society invites all people to use the restroom that aligns with their gender identity. For anyone who would like to use a gender-neutral restroom, we have identified the restroom on the *Lower Lobby* for that purpose. Take the stairwell from the pre-function space or elevator to LL for access.

Anti-harassment Policy and Code of Conduct

All OSA guests, attendees, and exhibitors are subject to the Code of Conduct policy, the full text of which is available at osa.org/codeofconduct. Conference management reserves the right to take any and all appropriate actions to enforce the Code of Conduct, up to and including ejecting from the conference individuals who fail to comply with the policy.

If you wish to report bullying, discrimination, or harassment you have witnessed or experienced, you may do so through the following methods:

- use the online portal osa.org/IncidentReport (or email CodeOfConduct@OSA.org)
- contact any OSA staff member (if onsite at an event or meeting)

Keynote and Tutorial Speakers

Keynote Speaker



Turan Erdogan, *Plymouth Grating Laboratory, Inc.*, USA
Monday, 08 July; 09:15—10:00

A Tale of Two Companies

Every company has a story. Many technology companies are run by or at least supported by technically smart people with little formal business training. Stories from other companies which have flourished, weathered tough times, or even failed miserably are vital learning tools for these technologists. This talk will compare the stories from two companies as they evolved from start-up to mid-life: Semrock and Plymouth Grating Laboratory. We will investigate how they handled similar challenges in different ways, and some critical decisions which they would or wouldn't make differently in hindsight.

About the Speaker

Turan Erdogan has been studying, teaching, and practicing optics for over 30 years. He is currently President of Plymouth Grating Laboratory, Inc. Prior to this, Erdogan was the Site Leader of Melles Griot in Rochester, New York, a leading provider of high-performance lens assemblies and optical modules for biological imaging and semiconductor metrology. He also served simultaneously as the CTO and VP of Business Development for the IDEX Optics & Photonics platform. In 2000, Erdogan co-founded Semrock, Inc., which was then acquired by IDEX in 2008. Semrock revolutionized the manufacturing of high-performance thin-film optical filters for fluorescence and Raman spectroscopy applications. Prior to Semrock, he was a tenured professor at the The Institute of Optics at the University of Rochester, where he joined in 1994. There he conducted research primarily on fiber and waveguide devices and holographic optical materials. Erdogan was also a post-doctoral researcher at Bell Laboratories, then part of AT&T. He has a Ph.D. from The Institute of Optics at the University of Rochester, and B.S. Degrees in Electrical Engineering and in Physics from the Massachusetts Institute of Technology.

Tutorial Speaker



Sujatha Ramanujan, *Luminate*, USA
Tuesday, 9 July; 08:30—10:00

From Lab to Launch, Growing your Start-up

There are unique challenges when bringing innovative optical and photonics products to market. This tutorial provides specialized instruction on how optics companies can navigate different stages of growth and development for start-ups and growth stage companies. We will begin by focusing on the use of accelerators such as Luminate and business incubation with success and improvement stories. We will then cover topics covered include methods for finding financial resources, advice on when to outsource, and best practices for developing and protecting intellectual property. Expect this to be a highly interactive workshop!

About the Speaker

Sujatha Ramanujan is serial entrepreneur and seasoned executive with 25 years of experience in Clinical Devices and in Consumer Electronics. Sujatha has started, built and grown three startup businesses in cardiac surgical equipment, optical communications and nano materials. In addition, as CTO and Product Line Manager of Mammography CAD and Pediatric Businesses within Kodak and Carestream, her team developed and launched clinical equipment and Clinical IT on every continent. Sujatha has held scientific, technical leadership, and laboratory head positions in Chrysler Corporation, GE, Kodak, Carestream, and Intrinsic Materials. She holds 28 issued US patents. As a corporate investor for Kodak, then later working with regional investment councils she provides guidance to start-ups, M&A strategies for growing businesses and vetting of technologies to investors. She has served on investment advisories in US, Canada, and Israel. Dr. Ramanujan holds a PhD in Electrical Engineering from the University of Michigan and is an Executive Board Member of the National Women's Hall of Fame.



Special Events

Keynote Session

Monday, 8 July, 09:00-10:00

The Applied Industrial Optics Topical meeting will feature Keynote speaker Turan Erdogan. For more information on the speaker, see the description on the previous page.

Panel: Small Business, Big Optics

Monday, 8 July, 16:30-18:30

The aim of this panel is to promote individual programs or offerings and provide background on topics such as calls for proposals, acceptance criteria, funding levels, aims of the programs, and technical focus.

Panelists:

Ben Schrag, *National Science Foundation, USA*
Brittany Sickler, *Small Business Administration, USA*
Ron Shiri, *National Aeronautics and Space Administration, USA*

Tutorial Session

Tuesday, 9 July, 08:30-10:00

The Applied Industrial Optics Topical meeting will feature Tutorial speaker Sujatha Ramanujan. For more information on the speaker, see the description on the previous page.

Panel: Optics on the Hill

Tuesday, 9 July, 16:30-18:30

This panel session will discuss (and likely educate the audience on) public policy, advocacy, and the vital promotional role the optics community plays in the broader political landscape.

Panelists:

Tanya Das, *US House of Representatives, USA*
Gerald T. Fraser, *National Institutes of Standards and Technology, USA*
David Lang, *The Optical Society, USA*

Break sponsored by:



Closing Reception

Wednesday, 10 July, 17:30-19:00

Join fellow attendees on the 6th floor of OSA for networking, hors d'ouerves, and drinks. The event is open to all conference attendees; attendees may purchase extra tickets for guests for \$75.



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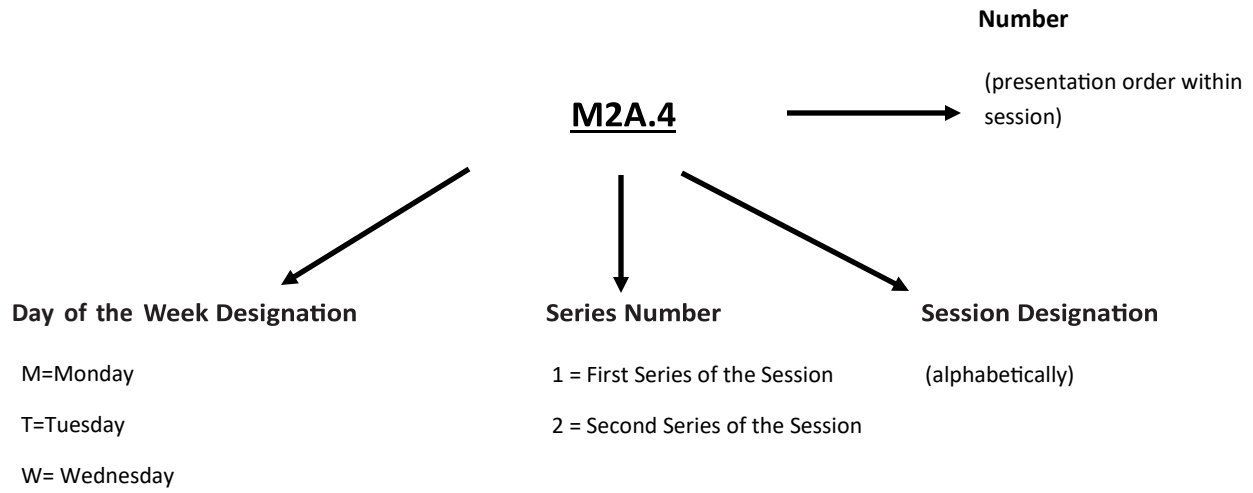
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Explanation of Session Codes



The first element denotes the day of the week . The second element indicates the session series in that day (for instance, 1 would denote the first sessions in that day). Each day begins with the letter A in the third element and continues alphabetically through the parallel session. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded M2A.4 indicates that this paper is being presented on Monday(M) in the second series of sessions (2), and is the first session (A) in that series and the fourth paper (4) presented in that session.

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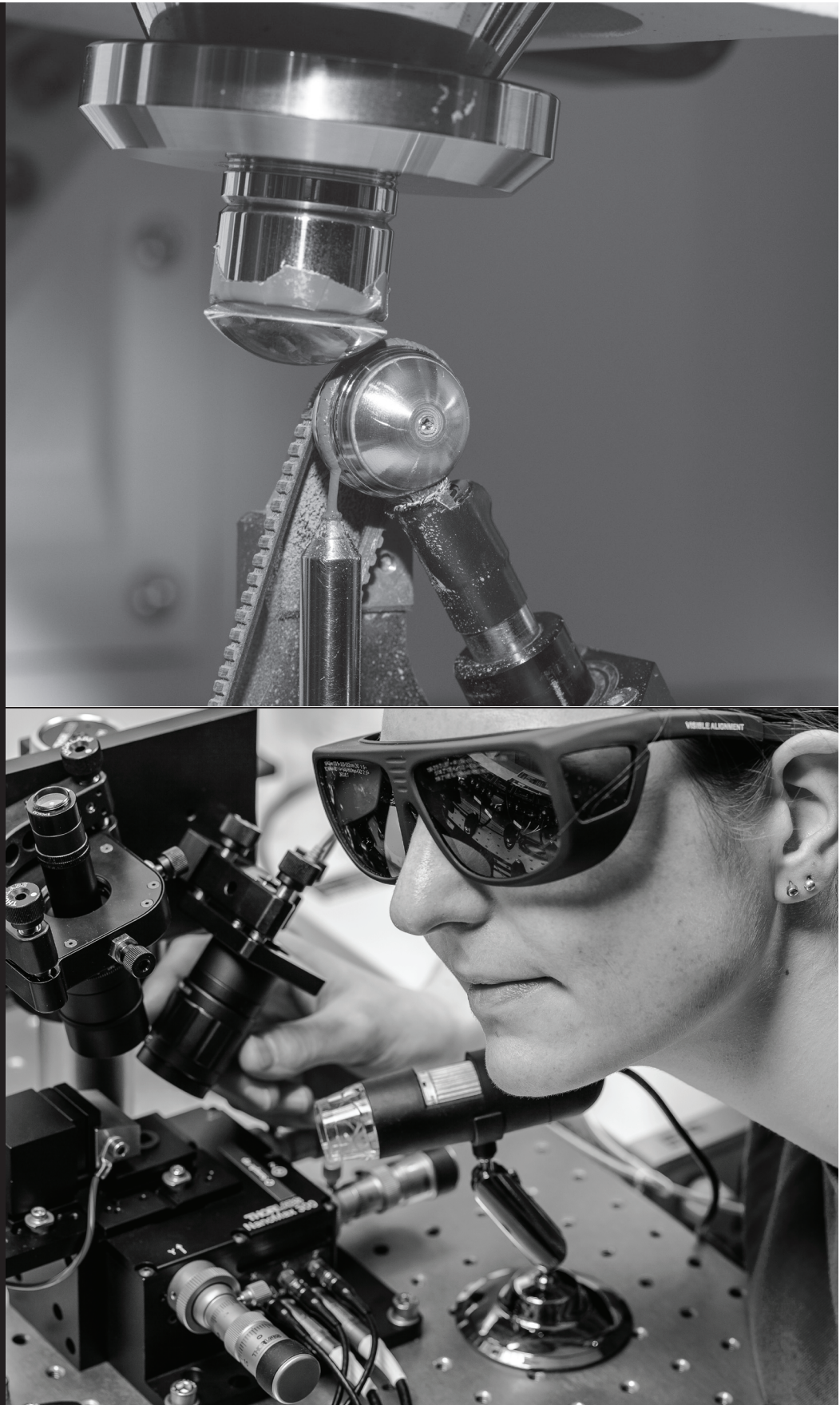
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Agenda of Sessions

Monday, 8 July	
08:00—17:00	Registration <i>Hosted Breakfast Available at 08:00</i>
09:00—10:00	M1A • Keynote Session
10:00—10:30	Networking Coffee Break; Pre-function Space
10:30—12:30	M2A • Close to Home
12:30—14:00	Hosted Lunch Break; Pre-function Space
14:00—16:00	M3A • Out of This World
16:30—18:30	M4A • Panel: Small Business, Big Optics <i>Break with refreshments 17:15-17:30</i>

Tuesday, 9 July	
07:30—17:00	Registration <i>Hosted Breakfast Available at 07:30</i>
08:30—10:00	T1A • Tutorial Session
10:00—10:30	Networking Coffee Break; Pre-function Space
10:30—12:30	T2A • Tune and Zoom
12:30—14:00	Hosted Lunch Break; Pre-function Space
14:00—16:00	T3A • Feelin’ the Heat, Seeing the Light
16:30—18:30	T4A • Panel: Optics on the Hill <i>Break with refreshments 17:15-17:30</i>

Agenda of Sessions

Wednesday, 10 July	
07:30—17:00	<p style="text-align: center;">Registration <i>Hosted Breakfast Available at 07:30</i></p>
08:45—10:00	W1A • UC 3D
10:00—10:30	Networking Coffee Break; Pre-function Space
10:30—12:00	W2A • Biophantastic!
12:30—14:30	Hosted Lunch Break; Pre-function Space
14:30—16:00	W3A • CHiPs
16:30—17:30	W4A • LIBS Hz
17:30—19:00	Closing Reception; 6th Floor Lounge

08:00—17:00 • Registration, Lobby

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Monday, 8 July

09:00— 10:00

M1A • Keynote Session

President: Gary Miller; US Naval Research Laboratory, United States

M1A.1 • 09:15 Keynote

A Tale of Two Optics Companies, Turan Erdogan¹; ¹*Plymouth Grating Laboratory, Inc., USA*. This talk will compare the stories from two optics companies as they evolved from start-up to mid-life: Semrock and Plymouth Grating Laboratory. We will investigate how they handled similar challenges in different ways.

10:00—10:30 • Networking Coffee Break, Pre-function Space

10:30—12:30

M2A • Close to Home

President: Simon Toft Sørensen; Tyndall National Inst., Ireland

M2A.1 • 10:30 Invited

A Smart Sky, Imitating the Atmosphere for a Different Approach to the Light Tunability, Simone Bonanomi^{1,2}, Sandro Usseglio Nanot¹, Vittorio Fossati¹; ¹*CoeLux Srl, Italy*; ²*Department of Science and High Technology, Univ. of Insubria, Italy*. We developed a diffusive material based on polymers and liquid crystals with an electrically controlled scattering cross section able to reproduce the full range of sun and sky colors.

M2A.2 • 11:00 Invited

Optical Aerosol Sensing – from Air Quality to Global Warming, Alexander Bergmann¹, Paul Maierhofer¹, Anton Buchberger¹, Philipp Breitegger¹; ¹*Inst. of Electronic Sensor Systems, Univ. of Technology Graz, Austria*. We have utilized three optical principles in a highly-integrated system to quantify particulates in air. The principles are light scattering, the interaction of particles with evanescent fields, as well as a photoacoustic QEPAS setup.

M2A.3 • 11:30 Invited

Monolithic micro spectrometer to determine best time to harvest fruits, Sven Schönfelder¹; ¹*INSION GmbH, Germany*. Monolithic micro spectrometers do not require recalibration and, due to their miniaturized and rugged design, they are ideally suited for hand-held devices and field measurements. Most of the annual apple harvest is stored in special warehouses for several months. By means of spectral sensors, the harvest time can be optimally determined in the field in order to avoid internal pulp discolorations in the shelf life and trading periods of the products.

M2A.4 • 12:00 Invited

Filter-less optical detection of multiple fluorophores, Mohiudeen Azhar¹, Ragavender M S¹, Karan Mohan², Paul Patt²; ¹*Siemens Healthcare Pvt Ltd, India*; ²*Siemens Healthcare Diagnostics Inc, USA*. Filter-less optical fluorescence detection offers maximum flexibility with choice of fluorophores and excitation wavelengths. Individual spectra in multiple overlapping fluorophore spectra are differentiated using linear matrix algebra algorithms.

12:30—14:00 • Hosted Lunch, Pre-function Space



14:00 — 16:00

M3A • Out of This World*President: Hans-Peter Loock; Queen's Univ. - Chemistry, Canada***M3A.1 • 14:00** **Invited**

Space Flight CCD and CMOS Imagers: Recent and Next Generation Developments, John Tower¹, Jim Janesick¹; ¹*SRI International, USA*. SRI space flight CCD and CMOS imagers are reviewed. Low light level TDI CCDs are described with on-orbit imagery presented. Recent and on-going CMOS flight projects are reviewed. Future development plans are described.

M3A.2 • 14:30 **Invited**

Engineering Laser Systems for Aerospace and Defense Applications, Nicholas W. Sawruk¹, Andrew M. Schober¹; ¹*Fibertek, Inc., USA*. Lasers for aerospace applications pose a unique set of challenges including harsh environments, limited volumes, power and thermal capacity of platforms. Fibertek will present examples of lasers transitioned from the lab to operational environments.

M3A.3 • 15:00 **Invited**

Sensor Systems using Tunable Micro-Electro-Mechanical Systems Vertical Cavity Surface Emitting Lasers (MEMS-VCSELs) from the Visible to the Mid-infrared, Vijaysekhar Jayaraman¹; ¹*Praevium Research, Inc., USA*. MEMS-VCSELs enable fractional tuning ranges of >11%, wavelength scan rates >1MHz, and dynamic single-mode operation. These properties promise an economical optical source for imaging, metrology, and spectroscopy from the visible to the mid-infrared.

M3A.4 • 15:30

Compact frequency-stabilised diode lasers for atom interferometry and optical clocks, John Macarthur¹, Christopher Carson¹, Brynmor E. Jones¹, Ludwig Prade¹, Douglas Bremner², William Dorward², Steve T. Lee², Stephen Robertson², Steve P. Najda³, P Perlin³, M Leszczynski³, Loyd McKnight¹; ¹*Fraunhofer Centre for Applied Photonics, UK*; ²*Opticap Ltd, UK*; ³*TopGaN Ltd, Poland*. Multiple laser-diode topologies designed for compact, stable, narrow-linewidth sources ranging from the blue (420 nm) to the red (780 nm) for use in quantum technology applications where absolute frequency accuracy and stability is key.

M3A.5 • 15:45

Wavelength-Switchable Fiber Bragg Grating Ring Laser Based on Temperature-Insensitive Spectral Polarization-Dependent Loss Element, Min Seok Kim¹, Jihoon Kim², Seul-Lee Lee¹, Sungwook Choi¹, Do Kyung Kim¹, Yong Wook Lee^{1,2}; ¹*Interdisciplinary Program of Biomedical, Mechanical & Electrical Engineering, Pukyong National University, Korea (the Republic of)*; ²*School of Electrical Engineering, Pukyong National University, Korea (the Republic of)*. We propose a wavelength-switchable fiber Bragg grating ring laser based on a temperature-insensitive spectral polarization-dependent loss element realized by inscribing a long-period fiber grating on polarization-maintaining photonic crystal fiber.

16:00—16:30 • Networking Coffee Break, Pre-function Space

16:30 — 18:30

M4A • Panel: Small Business, Big Optics*President: Garrett Cole; Crystalline Mirror Solutions LLC, USA*

The aim of this panel is to promote individual programs or offerings and provide background on topics such as calls for proposals, acceptance criteria, funding levels, aims of the programs, and technical focus.

PanelistsBen Schrag, *National Science Foundation, USA*Brittany Sickler, *Small Business Administration, USA*Ron Shiri, *National Aeronautics and Space Administration, USA*

P St

08:30 — 10:00

T1A • Tutorial Session

Presider: Arlene Smith; Avo Photonics Inc, USA

T1A.1 • 08:30 Tutorial

From Lab to Launch: Growing your OPI Business, Sujatha Ramanujan^{1,2}; ¹Luminate, USA; ²NextCorps, USA. The workshop addresses unique challenges faced when commercializing optics and photonics products. The Luminate accelerator will present example of successes and failures. Attendee teams will develop business strategies for a fictional venture.

10:00—10:30 • Networking Coffee Break, Pre-function Space

10:30 — 12:30

T2A • Tune and Zoom

Presider: Denis Donlagic; Univ. of Maribor, Slovenia

T2A.1 • 10:30

Modeling, Simulation and Manufacturing of Polymer Optical Waveguides by Using the OPTAVER Process, Thomas Reitberger¹, Jochen Zeitler¹, Carsten Backhaus², Gerd-Albert Hoffmann³, Alexander Wienke⁴, Lukas Lorenz⁵, Karlheinz Bock⁵, Klaus-Juergen wolter⁵, Oliver Suttman⁴, Ludger Overmeyer³, Norbert Lindlein², Joerg Franke¹; ¹FAPS, FAU Erlangen, Germany; ²ODEM, FAU Erlangen, Germany; ³ITA, LUH, Germany; ⁴LZH, Germany; ⁵AVT; TU Dresden, Germany. This paper shows the modeling, simulation and production of polymer optical waveguides using the OPTAVER process. The additive manufactured multimode waveguides with their typical cross-section of a circle shape are of low cost and high-performance

T2A.2 • 10:45 Invited

Adaptive Polymor Lenses at NRL, Freddie Santiago¹; ¹US Naval Research Laboratory, USA. We present an overview of the Adaptive Polymer Lenses (APLs) program at NRL. This encompass its early beginning to the current research in the last 4 years. Will present the work performed on the use of APLs for application ranging from imaging, beam control and non-mechanical zoom in the visible, near, short and mid-wave infrared. Also an overview of future developments and projects which implement the NRL APLs.

T2A.3 • 11:15 Invited

From Research Lab to Industry: Commercializing MEMS Focusing and Zoom Imaging Technology, Sarah Lukes¹, Demi St. John¹, Daniel Traucht¹, Sarah Mondl¹, Brandon Huntley¹, James Dilts¹, Tiphani Lynn¹; ¹Agile Focus Designs, USA. We present the evolution of initial imaging experiments and micro-electro-mechanical systems mirrors toward a commercialized product. Feasibility of 10-mm-diameter freestanding deformable mirrors for fast focus and zoom in microscopy is also shown.

T2A.4 • 11:45 Invited

Electrowetting Adaptive Optical Devices for LIDAR, Juliet Gopinath¹, Mo Zohrabi¹, Omkar Supekar¹, Wei Yang Lim¹, Baris Ozbay², Gregory Futia², Diego Restrepo², Emily Gibson², Victor Bright¹; ¹Univ. of Colorado at Boulder, USA; ²Univ. of Colorado Anschutz Medical Campus, USA. Electrowetting devices are compact, low power, transmissive, and adaptable. We have demonstrated nonmechanical beam steering in a LIDAR system and imaging in a multiphoton microscope, with an electrowetting prism.

T2A.5 • 12:15

Data fusion of Lidar and Thermal Camera for Autonomous driving, Shoaib Azam¹, Farzeen Munir¹, Ahmad Muqeem Sheri¹, YeongMin Ko¹, Ishfaq Hussain¹, Moongu Jeon¹; ¹GIST, Korea (the Republic of). The adverse environmental conditions build a bottleneck for the autonomous driving. This challenge is resolved by data fusion of sensor modalities. Here, thermal and Lidar data are fused together for the precise perception of environment.

12:30—14:00 • Hosted Lunch, Pre-function Space

14:00 — 16:00

T3A • Feelin' the Heat, Seeing the Light

President: Brandon Redding; US Naval Research Laboratory, USA

T3A.1 • 14:00

Fiber optic probe for process control in industrial copper smelters, Hans-Peter Loock¹, Arthur Stokreef¹, Jack A Barnes¹, Boyd Davis²; ¹Queen's Univ. - Chemistry, Canada; ²Kingston Process Metallurgy, Canada. A fiber-coupled pyrometer was used to monitor the temperature and brightness of the flame in an industrial copper smelter and lab-based drop tower with the aim to aid in the process control of these furnaces.

T3A.2 • 14:15 DEMO

Microstructured Optical Fiber High-Temperature Sensors, Stephen C. Warren-Smith^{1,2}, Erik P. Schartner^{1,2}, Linh V. Nguyen¹, Dale E. Otten³, Zheng Yu¹, David G. Lancaster³, Heike Ebendorff-Heidepriem^{1,2}; ¹Inst. for Photonics and Advanced Sensing (IPAS) and School of Physical Sciences, The Univ. of Adelaide, Australia; ²ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP), The Univ. of Adelaide, Australia; ³Physics and Photonic Devices Laboratories, School of Engineering and Future Industries Inst., Univ. of South Australia, Australia. We will present progress in using microstructured optical fibers with femtosecond laser ablation fiber Bragg gratings for temperature sensing in pyrometallurgical applications.

T3A.3 • 15:00 Invited

Tailored Delivery of Ultra-short High-energy Lasers for Improved Material Processing, Claude Aguergaray^{1,2}, Liam Barber^{1,2}, Jeffery Low^{1,2}, Simon Ashforth^{1,2}, Neil Broderick^{1,2}, Cather Simpson^{1,2}; ¹Univ. of Auckland, New Zealand; ²The Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand. We review some of the latest advances in beam delivery of high-energy femtosecond pulses. We focus on custom beam delivery via spatial beam shaping or via hollow core fibres for ultra-short pulse transportation.

T3A.4 • 15:30 Invited

Remote Electric Power Delivery via High Power Laser, Thomas J. Nugent¹; ¹Powerlight Technologies, USA. PowerLight Tech has developed safe, high power, remote delivery of power both through air or optical fiber by laser, for commercial uses. World-leading performance metrics meet the needs for commercialization.

16:00—16:30 • Networking Coffee Break, Pre-function Space

16:30 — 18:30

T4A • Panel: Optics on the Hill

President: Julia Majors; Avo Photonics, USA

This panel session will discuss (and likely educate the audience on) public policy, advocacy, and the vital promotional role the optics community plays in the broader political landscape.

Panelists

Tanya Das, US House of Representatives, USA

Gerald T. Fraser, National Institutes of Standards and Technology, USA

David Lang, The Optical Society, USA

Break sponsored by:



Tuesday, 9 July

P St

08:45—10:00

W1A • UC 3D

Presider: Gary Miller; US Naval Research Laboratory, USA

W1A.1 • 08:45 **Invited**

Architecture and Building Blocks for Optical Wafer Level Integrated Chip Scale Sensors, Rainer M. Minixhofer¹; ¹R&D, ams AG, Austria. To address today's challenges towards miniaturization for optical sensor systems, the architecture and key components of wafer level integrated sensors are outlined. The concept is demonstrated for the case of an ambient light sensor.

W1A.2 • 09:15 **DEMO**

Realvision 3D Technology: Experiencing the Real Way of Seeing, Lisa Franceschini¹; ¹Realvision SRL, Italy. The Realvision 3D was developed to represent as faithful as possible human vision. Given the absence of any kind of filter and through its unique technology, the Realvision 3D provides a real visual experience without alterations of visual function.

10:00—10:30 • Networking Coffee Break, Pre-function Space

10:30 — 12:30

W2A • Biophantastic!

Presider: Ivan Capraro; Adaptica Srl, Italy

W2A.1 • 10:30 **Invited**

A novel opto-fluidic engine for adaptive eyeglasses: technology approach and experimental results, Bruno Berge¹, Jessica Jarosz¹, Simon Kulifaj¹, Norbert Molliex¹; ¹Laclarée, France. A new opto-fluidic engine for eyeglasses correcting presbyopia, with both large diameters and large dioptric ranges, will be presented and positioned in the map of existing variable lens technologies.

W2A.2 • 11:00 **Invited**

Phantom-based model eyes for adaptive optics performance assessment, Daniel X. Hammer¹, Nikita Kedia^{1,2}, Zhuolin Liu¹, Johnny Tam³, Anant Agrawal¹; ¹Food and Drug Administration, USA; ²A. James Clark School of Engineering, Univ. of Maryland, USA; ³National Eye Inst., National Inst. of Health, USA. Ophthalmic adaptive optics (AO) senses and corrects for ocular aberrations providing cellular-level resolution of the retina. We developed a biomimetic AO model eye that can be used to evaluate and quantify AO device performance.

W2A.3 • 11:30 **Invited**

Multimode and Double-Clad Fiber Couplers for Biomedical Optics, Caroline Boudoux^{2,1}, Kathy Beaudette¹, Lucas Majeau¹, Nicolas Godbout^{2,1}; ¹Castor Optics, Inc., Canada; ²Engineering Physics, Polytechnique Montréal, Canada. Medical imaging brings a new set of constraints on light delivery instrumentation. To support these applications, we have developed asymmetrical couplers for efficient single-fiber illumination/detection. We present double-clad fiber couplers and wideband multimode circulators for imaging and optogenetics.

W2A.4 • 12:00

Temperature-Insensitive Directional Twist Measurement Based on Fiber Transmission Grating Written on Birefringent Photonic Crystal Fiber, Do Kyung Kim¹, Jihoon Kim², Seul-Lee Lee¹, Sungwook Choi¹, Min Seok Kim¹, Yong Wook Lee^{1,2}; ¹Interdisciplinary Program of Biomedical, Mechanical & Electrical Engineering, Pukyong National Univ., Korea (the Republic of); ²School of Electrical Engineering, Pukyong National Univ., Korea (the Republic of). Here we experimentally demonstrated temperature-insensitive directional twist measurement using a fiber transmission grating written on birefringent photonic crystal fiber by CO₂ laser pulses at a twist measurement range from -200° to +200°.

W2A.5 • 12:15

Confocal Multi-line Scanning Microscope for Efficient 3D Fluorescence Imaging, Leon van der Graaff¹, Sjoerd Stallinga¹; ¹Delft Univ. of Technology, Netherlands. We propose an architecture for highly efficient 3D line confocal fluorescence imaging. We use a tilted area sensor in combination with a multi-line illumination to acquire image data of multiple depths simultaneously.

12:30—14:30 • Hosted Lunch, Pre-function Space

14:30 — 16:00

W3A • CHiPs

President: Thomas Haslett; Avo Photonics Inc, Canada

W3A.1 • 14:30 **Invited**

Chip-scale Digital Fourier Transform Spectroscopy, Juejun Hu¹; ¹Massachusetts Inst. of Technology, USA. We describe an on-chip digital Fourier transform spectrometer and an algorithm for spectrum reconstruction. Its resolution scales exponentially with footprint and we realize 100% resolution enhancement compared to the Rayleigh criterion.

W3A.3 • 15:00 **Invited**

Polygon scanner based ultra-short pulse laser processing for continuous structuring of photomask resists, Martin Priwisch¹, Sebastian Dormann¹, Clemens Hoenninger², Lars Penning³, Ronny De Loor³, David Bruneel⁴; ¹Fraunhofer IPT, Germany; ²R&D, Amplitude Systèmes, France; ³Next scan technology, Belgium; ⁴Lasea, Belgium. Enabling of continuous photomasking using a pulsed laser source and polygon scanners to achieve high repetition rates and pulse energy, precise beam guiding and stable handling of the moving web with the applied photomask resist.

W3A.4 • 15:30 **Invited**

Breaking the Electrical Communications Bottleneck with Optical I/O, Mark T. Wade¹; ¹Ayar Labs, USA. As chip-to-chip communication bandwidths increase into the multi-Tbps regime, electrical signaling is fast approaching performance limitations due to signal integrity issues. A new generation of electronic-photonic systems and architectures has been developed to increase the bandwidth, energy efficiency, and reach of chip-to-chip communications. This talk will present the core problem being solved, the solutions offered by emerging electronic-photonic technologies, and the challenges and opportunities that remain on the road to productization.

16:00—16:30 • Networking Coffee Break, Pre-function Space

16:30 — 17:30

M4A • LIBS Hz

President: Arlene Smith; Avo Photonics Inc., USA

W4A.1 • 16:30 **Invited**

Implementation of LIBS in Industrial Environments: Sorting out Good Applications, Steven G. Buckley¹; ¹Flash Photonics, Inc., USA. Abstract not available.

W4A.2 • 17:00

Reliable In-situ Thickness Monitoring of Multilayer Paints Based on THz Time Domain Spectroscopy, Andreas Frank¹, Deran J. Maas¹, Jacobus L. van Mechelen¹; ¹ABB Switzerland Ltd, Switzerland. We present a femtosecond laser-based THz paint analyzer for measuring wet and dry paint multilayers insensitive to surface curvatures and vibrations. Multiple layers can be measured simultaneously with an average error smaller than 1.1 μm .

W4A.3 • 17:15

Terahertz multispectral imaging of multi-walled carbon nanotube films on silicon wafer, Anis Rahman^{1,2}; ¹Applied Research and Photonics Inc, USA; ²Harrisburg Univ. of Science and Technology, USA. Terahertz multispectral imaging for sub-nanoscale investigation is utilized to determine the thicknesses of single-walled carbon nanotube films on silicon wafer. The measured thicknesses vary systematically as a function of alignment, as expected.

17:30—19:00 • Closing Reception, 6th Floor Lounge

Wednesday, 10 July

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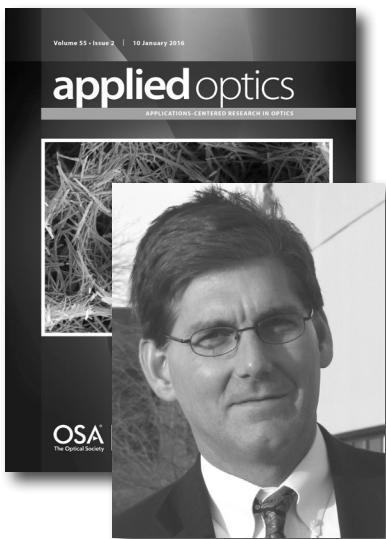
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