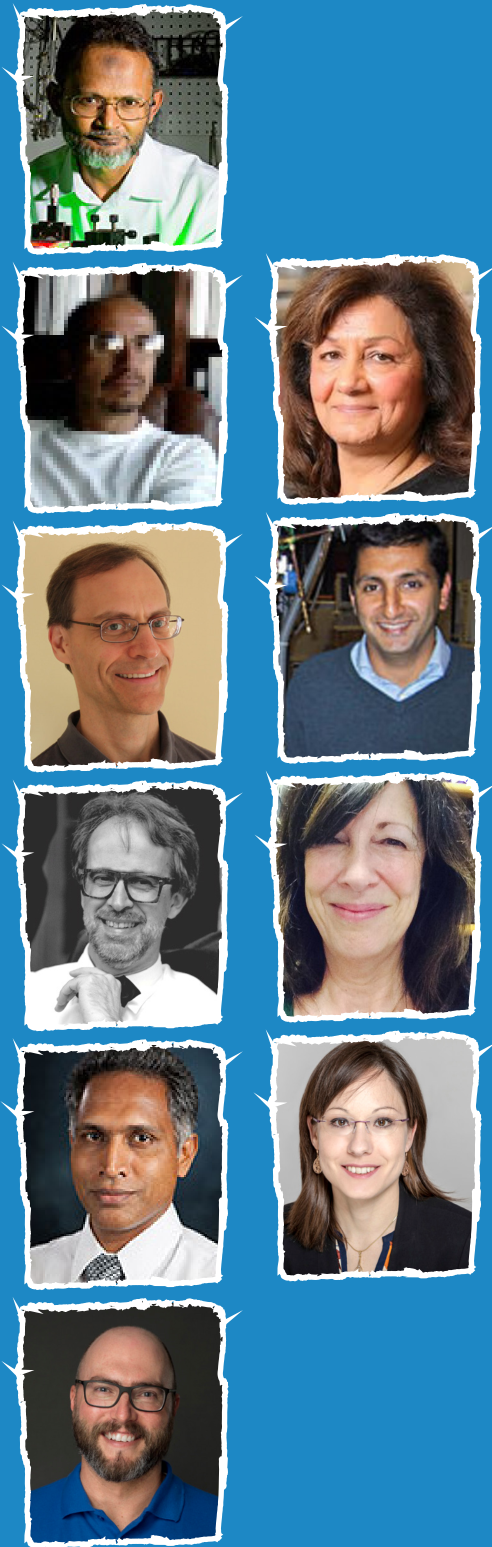
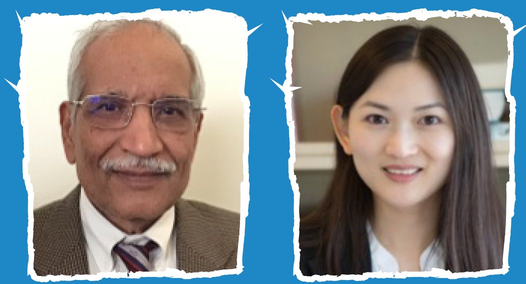
International Webinar Scientific Conference on

LASERS, OPTICS, PHOTONICS & SENSORS

June 12-13 2021 | Webinar



https://lopsconference.com/speakers.php



CONFERENCE FEEDBACK

Duration	Type	Code	Notes
45	Plenary	P	Duration: 45 minutes
30	Keynote	K	Duration: 30 minutes
25	Invited	I	Duration: 25 minutes
15	Student	S	Duration: 15 Minutes
20	Coffee Break	CB	Duration: 20 Minutes
30	Lunch Break	LB	Duration: 20 Minutes
10	Opening Ceremony	O	Duration: 10 Minutes
5	Closing Ceremony	C	Duration: 5 Minutes
0	End	e	

Start Time	8:00AM	8	0	

Saturday June 12, 2021 - All the Time are in USA Eastern Standard Time

Presenters local Time	EST Timing	Paper #	Code	Min	Session I - Presenter/Paper Title	Chair/Session Chair
Pasadena, USA: 5:00 AM	8:00AM	Opening Ceremony	O	10	**Kazemi Alex,** Chairman LOPS Conferences,	Alex Kazemi
New York, USA: 8:10 AM	8:10AM	LOPS2021-P02	K	30	**Alfano:** Advances In Supercontinuum -The Ultimate Ultrafast White Light - and Ultra-supercontinuum broadening from self-phase modulation for isotropic condensed media with extremely intense femtosecond pulses	Alex Kazemi
Pasadena, USA: 5:40 AM	8:40AM	LOPS2021-S01	K	30	**Kazemi:** Micro FBG Sensor Systems for Aircraft Wing Drag Optimization	Alex Kazemi
Evanston, USA: 8:10 AM	9:10AM	LOPS2021-P01	P	45	**Razeghi:** Quantum Science and Technology	Alex Kazemi
USA EST: 9:55 PM	9:55AM		CB	20	**Coffee Break**	
Delft, Netherland: 4:15 PM	10:15AM	LOPS2021-S03	K	30	**Dam:** Long-range, hysteresis-free and fast optical hydrogen sensing using transition metal hydrides	Alex Kazemi
Melbourne, USA: 10:45 AM	10:45AM	LOPS2021-O01	K	30	**Murshid:** High-speed optical fiber communications architecture combining SDM and OAM based designs with PAM4 and WDM systems	Alex Kazemi
Redondo, USA : 8:15 AM	11:15AM	LOPS2021-S02	K	30	**Mendoza:** Wearable Personal Point-of-Care Multi-Parameter Vital-Sign Physiology Optical Sensing Monitor (VISIOM™) System	Alex Kazemi
Strasbourg, France: 5:45 PM	11:45AM	LOPS2021-S05	K	30	**Javahiraly:** Plasmonic micro sensor for pesticides detection	Alex Kazemi
USA EST: 12:15 PM	12:15PM		LB	30	**Lunch Break**	

Presenters local Time	EST Timing	Paper #	Code	Min	Session II- Presenter/Paper Title	Chair/Session Chair
Nottingham, UK: 5:35 PM	12:35PM	LOPS2021-S06	I	25	**Phang:** A traffic light diagnostic inspired by neuromorphic system.	Syed Murshid/ I. Kymissis
Massachusetts, USA: 1:00 PM	1:00PM	LOPS2021-O03	K	30	**Fantini:** Dual slopes in diffuse optics	Syed Murshid/ I. Kymissis
Washington DC, USA: 1:30 PM	1:30PM	LOPS2021-L03	K	30	**Afanasev:** Novel Propagation Modes of Twisted Light in Spatially Dispersive Matter	Syed Murshid/ I. Kymissis
Golden, USA: 12:00 PM	2:00PM	LOPS2021-L07	I	25	**Knabe:** Robust, Field-deployed Laser Modules For Next Generation Quantum Sensors	Syed Murshid/ I. Kymissis
Waco, USA: 1:25 PM	2:25PM	LOPS2021-L04	I	25	**Olafsen:** Optical Pumping and Reduction of Droop in Interband Cascade Lasers	Syed Murshid/ I. Kymissis
USA EST: 2:50 PM	2:50PM		CB	20	**Coffee Break**	
New York, USA: 3: 10 PM	3:10PM	LOPS2021-L01	I	25	**Kymissis:** MicroLEDs and OLEDs for Non-Display Applications	Syed Murshid/ S. Fantini
Irvine, USA: 12:35 PM	3:35PM	LOPS2021-O07	K	30	**Chen:** Frontier in Optical Coherence Tomography: Doppler OCT, OCTA, and Optical Coherence Elastography	Syed Murshid/ S. Fantini
Connecticut, USA: 4:05 PM	4:05PM	LOPS2021-O09	K	30	**Dutta:** Semiconductor Optical Amplifiers for Optical logic Applications	Syed Murshid/ S. Fantini
Pittsburgh, USA: 4:35 PM	4:35PM	LOPS2021-O24	K	30	**Jana:** Diffuse optical spectroscopy-based biomarkers of cerebral health	Syed Murshid/ S. Fantini
Baltimore, USA: 5:05 PM	5:05PM	LOPS2021-O11	K	30	**Gramatikov:** Ophthalmic polarization-sensitive diagnostic technologies employing retinal birefringence scanning	Syed Murshid/ S. Fantini
Illionis, USA: 4:35 PM	5:35PM	LOPS2021-P10	K	30	**Stem:** Coherent poly propagation materials with 3-dimensional photonic control over visible light	Syed Murshid/ S. Fantini
	6:05PM		e			

Duration	Type	Code	Notes
30	Keynote	K	Duration: 30 minutes
25	Invited	I	Duration: 25 minutes
15	Student	S	Duration: 15 minutes
20	Coffee Break	CB	Duration: 20 Minutes
30	Lunch Break	LB	Duration: 30 Minutes
0	End	e	

	Start Time	8:00AM	8	0		

Sunday June 13, 2021 All the Time are in USA Eastern Standard Time

Presenters local Time	EST Timing	Paper #	Code	Min	Session III - Presenter/Paper Title	Chair/Session Chair
South Hampton, UK: 1:00 PM	8:00AM	LOPS2021-O02	K	30	**Poletti:** Hollow core fibers: sensing, machining and communicating with air-guided light	Bernard Dam/ Poletti
Duisburg, Germany: 2:30 PM	8:30AM	LOPS2021-P04	K	30	**Siesler:** Customer-Affordable Handheld Near-Infrared Spectrometers: On-Site Quality Control and Protection against Product Counterfeiting	Bernard Dam/ Poletti
Orlando, USA: 9:00 AM	9:00AM	LOPS2021-P03	K	30	**Delfyett:** Ultrafast Photonics Techniques and Applications - Communication and Signal Processing at the Speed of Light	Bernard Dam/ Poletti
Urbana, USA: 8:30 AM	9:30AM	LOPS2021-O10	I	25	**Dragic:** Advanced optical fiber systems: What do we really need from the fiber?	Bernard Dam/Poletti
USA EST: 9:55 AM	9:55AM		CB	20	**Coffee Break**	
FortLauderdale, USA: 10:15AM	10:15AM	LOPS2021-L08	I	25	**Craddock:** Fano Resonances in the Resonance Raman Spectra of Tubulin and Microtubules Reveals Active Quantum Effects	Bernard Dam/ Delfyett
Prague, Czech Republic: 4:40 PM	10:40AM	LOPS2021-O14	I	25	**Vojtech :** Transmission of Precise Time and Ultrastable Optical Frequency within Telecommunication Networks	Bernard Dam/ Delfyett
Olching, Germany: 5:05 PM	11:05AM	LOPS2021-L02	I	25	**Kunsch:** Recent Progress & Possible Trends in Infrared Technologies	Bernard Dam/ Delfyett
Birmingham,UK: 4:30 PM	11:30AM	LOPS2021-P05	I	25	**Meglinski:** Spin Angular Momentum of Light In Digital Histopathology	Bernard Dam/ Delfyett
Paris, France: 5:55 PM	11:55AM	LOPS2021-O12	I	25	**Sarayeddine:** Display optics Challenges for AR Smart Glasses. The monolithic plastic optics solution	Bernard Dam/ Delfyett
Melbourne, USA: 12:20 PM	12:20PM	LOPS2021-L05	K	30	**Arrasmith:** High-speed, High-accuracy Direct General Transfer Function Estimation Using a new Well-Optimized Linear Finder (WOLF) Method with Application to Diversity-based Atmospheric Turbulence Compensated Imaging Systems	Bernard Dam/ Delfyett
USA EST: 12:50 PM	12:50PM		LB	30	**Lunch Break**	

Presenters local Time	EST Timing	Paper #	Code	Min	Session IV - Presenter/Paper Title	Chair/Session Chair
Cranfield, UK: 06:20 PM	1:20PM	LOPS2021-L09	I	25	**Suder:** Challenges in high power laser processing	Ed Mendoza / Ballato
Huntsville, USA: 12:45 PM	1:45PM	LOPS2021-L10	K	30	**Sirohi:** Shearography and its applications	Ed Mendoza / Ballato
Norcross, USA: 2:15 PM	2:15PM	LOPS2021-O10	K	30	**Westbrook:** Enhanced Optical Fibers for Next Generation Distributed Sensing	Ed Mendoza / Ballato
Houston, USA: 1:45 PM	2:45PM	LOPS2021-S07	K	30	**Varghese:** Exceptional Properties of Hierarchical Oxide Nanostructures for Energy and Medicine	Ed Mendoza / Ballato
USA EST: 3:15PM	3:15PM		CB	20	**Coffee Break**	
New York, USA: 3:35 PM	3:35PM	LOPS2021-P08	I	25	**Pu, Yang:** Bridging the gap between optics and life science using Photoacoustic and nonlinear optical microscopy	Ed Mendoza/ Westbrook
North Dakota,USA: 3:00 PM	4:00PM	LOPS2021-S08	I	25	**Wang:** A novel nanocomposite based on 2D nanosheets, Ti3C2 MXene and 1D nanowires, KxWO for application in diabetes care	Ed Mendoza/ Westbrook
New Haven, USA: 4:25 PM	4:25PM	LOPS2021-L11	I	25	**Binlin:** Intraoperative margin detection and grading of human meningioma using a handheld visible resonance Raman analyzer and machine learning	Ed Mendoza/ Westbrook
Chandler, USA: 1:50 PM	4:50PM	LOPS2021-L12	I	25	**Babic:** Lead Selenide Transport and Conductivity Mechanism	Ed Mendoza/ Westbrook
Torrance, USA: 2:15 PM	5:15PM	LOPS2021-P15	I	25	**Indu Fiesler:** Acousto-ultrasonics applications of fiber optic sensors	Ed Mendoza/ Westbrook
Sydney, Australia: 7:40 AM	5:40PM	LOPS2021-P09	I	25	**Kazemikhoo:** Effect of photo biomodulation on the healing process of donor site in patients with grade 3 burn ulcer after skin graft surgery (a randomized clinical trial)	Ed Mendoza/ Westbrook
USA EST: 5:40 PM	5:40PM		e			

Duration	Type	Code	Notes
30	Keynote	K	Duration: 30 minutes
25	Invited	I	Duration: 25 minutes
15	Student	S	Duration: 15 minutes
20	Coffee Break	CB	Duration: 20 Minutes
30	Lunch Break	LB	Duration: 30 Minutes
	End	e	

	Start Time	8:00AM	8	0

Monday June 14, 2021 All the Time are in USA Eastern Standard Time

Presenters local Time	EST Timing	Paper #	Code	Min	Session V - Presenter/Paper Title	Chair/Session Chair
Strasbourg, France: 2:00 PM	8:00AM	LOPS2021-S04	K	30	**Javahiraly:** Review on the progress of nano-sensors for hydrogen leaks – nanostructured sensors based on palladium nanoparticles	Nicolas Javahiraly/ Seddon
Tehran, Iran: 5:00 PM	8:30AM	LOPS2021-P07	I	25	**Zandi:** Design of a high-performance photoconductive terahertz modulator enhanced by photonic crystal cavity	Nicolas Javahiraly/ Seddon
Meghalaya, India: 5:25 PM	8:55AM	LOPS2021-O23	I	25	**Nitu:** Control field Rabi frequency managed broadband supercontinuum generation in a semiconductor quantum well nanostructure	Nicolas Javahiraly/ Seddon
Semnan, Iran: 5:50 PM	9:20AM	LOPS2021-L15	I	25	**Ajami:** Dispersive White Light Supercontiuum Single Z-scan: A new method to determine the two-photon absorption spectrum	Nicolas Javahiraly/ Seddon
Tehran, Iran: 6:15 PM	9:45AM	LOPS2021-L14	I	25	**Dorranian:** Review on lasers synthesis and processing of nanostructures	Nicolas Javahiraly/ Seddon
USA EST: 10:10 AM	10:10AM		CB	20	Coffee Break	
Quebec, Canada:10:30 AM	10:30AM	LOPS2021-O07	I	25	**Thibault:** Using Deep Learning in Optical System and Lens Design	Nicolas Javahiraly/ Shi
Nottingham, UK: 3:55 PM	10:55AM	LOPS2021-O05	I	25	**Seddon:** Mid-infrared sources, based on chalcogenideglass fibers	Nicolas Javahiraly/ Shi
British Columbia, Canada: 8:20 AM	11:20AM	LOPS2021-L06	I	25	**Zeng:** In vivo multiphoton microscopy and multiphoton absorption based laser therapy	Nicolas Javahiraly/ Shi
Clemson, USA: 11:45 AM	11:45AM	LOPS2021-O04	I	25	**Ballato:** Fascinating materials science for advanced optical fibers	Nicolas Javahiraly/ Shi
San Diego, USA: 9:10 AM	12:10PM	LOPS2021-O06	I	25	**Shi:** Optical metabolic imaging of cells and tissues	Nicolas Javahiraly/ Shi
USAEST: 12:35 PM	12:35PM		LB	30	Lunch Break	

Presenters local Time	EST Timing	Paper #	Code	Min	Session VI - Presenter/Paper Title	Chair/Session Chair
Evanston, USA: 12:05 PM	1:05PM	LOPS2021-P12	I	15	**Gautam:** Geiger mode AlGaN UV APD with single photon detection	Alex Kazemi/ William Arrasmith
New York, USA: 1:20 PM	1:20PM	LOPS2021-P13	I	15	**Meyer:** Femtosecond Conical Emission in BK-7 Glass and the Influence of the Transient Kerr Nonlinear Index	Alex Kazemi/ William Arrasmith
Evanston, USA: 12:35 PM	1:35PM	LOPS2021-P14	I	15	**Junhee:** Si-doped p-type Ga2O3 grown by MOCVD and its field-effect transistors	Alex Kazemi/ William Arrasmith
Melbourne, USA: 1:50 PM	1:50PM	LOPS2021-O16	I	15	**Ce (Samuel) Su:** Optical Simulation Tool for SDM Communication System based on Off-Axis Parabolic Mirror	Alex Kazemi/ William Arrasmith
					Coffee Break	
Melbourne, USA: 2: 25 PM	2:25PM	LOPS2021-O17	S	15	**Tu, Mingxuan :** Analysis of SDM Optical Communications System Using Optisystem and Zemax	Alex Kazemi/ William Arrasmith
Orlando, USA: 2:40 PM	2:40PM	LOPS2021-O18	S	15	**Chinmay:** PAM-4 Data Transmission using Modulation Instability Frequency Combs on a Kerr Microresonator platform	Alex Kazemi/ William Arrasmith
Melbourne, USA: 2: 55 PM	2:55PM	LOPS2021-O19	S	15	**Coon:** Performance of a real-time atmospheric turbulence compensation methodology operating on aberrations modeled with Von Karman statistics	Alex Kazemi/ William Arrasmith
Melbourne, USA: 3:10 PM	3:10PM	LOPS2021-O20	S	15	**Coots:** Infrasound to Optics: System Noise Reduction Using New M.I.D.A.S. Filter With Wavelet-based Pre-Processor	Alex Kazemi/ William Arrasmith
Melbourne, USA: 3:25 PM	3:25PM	LOPS2021-O21	S	15	**He, Erlin:** Well Optimized Linear Finder (WOLF) Atmospheric Turbulence Compensation (ATC) computational speed improvement through the adoption of parallel, pre-calculated constant complex exponential phase difference chains.	Alex Kazemi/ William Arrasmith
Melbourne, USA: 3:40 PM	3:40PM	LOPS2021-O22	S	15	**Xin, Yang:** Order Analysis Comparison between traditional Fourier Transform-based atmospheric turbulence compensation methods and new Well Optimized Linear Finder Methodology	Alex Kazemi/ William Arrasmith
Wellington, New Zealand: 7:55 AM"	3:55PM	LOPS2021-O13	I	25	**Doronin:** A unified platform for simulating light transport in turbid media and its applications in Optical Diagnostics, Sensing and Computer Graphics	Alex Kazemi/ William Arrasmith
Pasadena, USA:1:25 PM	4:20PM		C	5	**Closing Ceremony**	Alex Kazemi/ William Arrasmith
USA EST: 4:25 PM	4:25PM		e		End	

Conference Souvenir and Certificates will be posted in the chat box during the conference and emailed to to all attendees after the conference

With the great support from the Organizing Committee includes The Conference Chairman and Chief Executive Committee, LOPS Conferences organizing 2nd International Scientific Conference on Lasers, Optics, Photonics and Sensors during June 10-12, 2022 in Fort Lauderdale, Florida, USA

Major Scientific & Technical (Business) Sessions

LASERS

- Biomedical and Therapeutic Laser
- Fiber Lasers and Applications
- High Intensity Lasers & High Field Phenomena
- Laser Applications in Life Sciences
- Laser Spectroscopy and Microscopy imaging
- OPO Lasers
- Plasma Technologies
- Quantum Electronics and Laser Science
- Quantum Information & Measurement
- Semiconductor Lasers & LEDs
- Single Photon Sources for Quantum Effects
- Structure OAM Lasers Beams
- Supercontinuum Lasers
- Tunable Lasers
- Ultrafast Picosecond/Femtosecond/ Attosecond lasers

OPTICS

- 2PEF & 3 PEF microscope imaging
- Adaptive Optics
- Applied Industrial Optics
- Biomedical Optics spectroscopy & imaging
- Complex & Structure Light of Spin Angular Momentum (SAM) & Orbital Angular Momentum (OAM) Beams
- Computational Optical Sensing & Imaging
- Correlation for Quantum Entanglement
- Fiber Optics Technology
- Fluorescence, Raman, Absorption
- Light propagation in scattering media
- Light-Matter Interaction
- Local & Nonlocal Photon beams
- Nonlinear Crystals & Optics
- Optical Communications & Networking
- Optical Instrumentation
- Optical Materials & Devices
- Optical spectroscopy
- Optics in Astronomy & Astrophysics
- Polarization States, Polarizers & WavePlates
- Q plates & Spatial Light Modulators (SLM)
- Resonance Raman spectroscopy
- SHG, THG, SRS, 4 Wave Mixing
- Special Function optical beams – Bessel, Laguerre Gaussian, Airy & Hermite optical beams
- Spectroscopy, Imaging & Metrology
- Stimulated Raman Gain /Loss imaging
- Tractor beams and nano-rotators
- Windows in NIR & SWIR Spectral Regimes for Transmission

PHOTONICS

- Cell phone with diagnostic capability
- Compact Photonic & Optoelectronic Materials & Devices
- Compact smart spectral photon & imagers
- Fiber Optics Devices
- Microphotonics, Nanophotonics & Optical Manipulation
- Microwave Photonics
- Molecular Photophysics and Spectroscopy
- Nonlinear Optics and Photonics
- Optical Coherence Tomography Technologies
- Organic and Bio-Photonics
- Photodetectors, Sensors and Imaging
- Photonic and Optoelectronic Materials & Devices
- Photonic and Optoelectronic Materials and Devices
- Photonics for Energy & Green Photonics
- Plasmonic Structures & Quantum Dots
- Quantum effect and entangled photons
- Silicon like Ge Si detector & Laser devices
- Ultrafast Phenomena, Attosecond Science & Technology
- Translational Optical Coherence Tomography
- Photoacoustics
- Advanced Microscopy & Spectroscopy
- Multimodal Biomedical Imaging

SENSORS

- Applied Industrial Spectroscopy
- Biosensors and Bioelectronics
- Compact PMT, Avalanche & Pin Diodes
- Computational Optical Sensing & Imaging
- Gas Sensors Based on Conducting Metal Oxides
- Metabolism Detection for Lipids & Protein
- Mobile Sensors
- Molecular Sensors & Nanodevices
- Nano Optoelectronic Sensors and Devices
- Nanomaterials for Biosensors
- Optical Biosensors
- Optics & Photonics for Sensing the Environment
- Optofluidics, Sensors & Actuators in Microstructured Optical Fibers
- Opto-Mechanical Fiber Optic Sensors
- Photo Acoustics Sensing, Detection & Imaging
- Photodetectors in UV, Visible, NIR, SWIR & MIR
- Printed Films
- RFID & Wireless Sensors using Ultra-Wideband Technology
- Semiconductor Gas Sensors
- Semiconductor Nanomaterials for Flexible Technologies
- Sensors and Actuators
- Smart Sensors

BIOPHOTONICS

- Bioimaging
- Biophotonics Techniques
- Cellular level diagnosis
- Clinical Biophotonics
- Diagnostic biophotonics
- Optical coherence tomography (OCT)
- Optical endoscopes
- Optical tagging
- Photobiostimulation
- Therapeutic biophotonics
- Thermal contact
- Visualization of complex structures

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

June 12-14 2021 | Webinar

DAY 1

https://lopsconference.com/speakers.php

Ultra-supercontinuum broadening from self-phase modulation for isotropic condensed media with extremely intense femtosecond pulses

Robert R. Alfano
Institute for Ultrafast Spectroscopy and Lasers The City College of New York, United States

KEYNOTE SPEAKER

Ultra-supercontinuum (USC) broadening has been theoretically stimulated from the envelope response to the fifth- and third-order susceptibilities under the influence of an extremely high-intensity bright femtosecond laser pulse to produce extremme spectra broadening changes extending from extreme X rays , XUV , UV , visble , NIR ,MIR , IR and THz to even DC to fill most of the Maxwell Rainbow .

The theoretical results show that an extremely high-intensity pulse as high as on the order of 1014~1016 W/m2 can influence the refractive index arising from both fifth-order susceptibility large enough that the nonlinear n4I02 term to overtakes the n2I0 term to produce the ultra-supercontinuum broadening in the liquids such as CS2 and rare gas liquids and solids such as Argon and Krypton. There has been experimental verification at lower intensities that the SC extends from, UV visible, NIR, to MIR by many researchers using various states of matter. This provides opportunity to extend SPM model from X rays to DC to form USC using extreme intensity pulses in four states of matter and generate attosecond pulses from other states of matter using the SPM model.

Using the electronic response of n2 and n4 for extreme intensinies of laser pulses Carrier Evelope Phase , HHG generation can be explained in gases, and condensed matter.

This research is performed with Shah Fasisal Mazhar and Lingyan Shi

Biography

In 2019, Robert Alfano received SPIE (Society of Photo-Optical Instrumentation Engineers) Gold Medal Award, the highest honor bestowed by the society. Robert Alfano is an Italian-American experimental physicist. He is a Distinguished Professor of Science and Engineering at the City College and Graduate School of New York of the City University of New York, where he is also the founding Director of the Institute for Ultrafast Spectroscopy and Lasers (1982). He is a pioneer in the fields of Biomedical Imaging and Spectroscopy, Ultrafast lasers and optics, tunable lasers, semiconductor materials and devices, optical materials, biophysics, nonlinear optics and photonics; he has also worked extensively in nanotechnology and coherent backscattering. His discovery of the white-light supercontinuum laser is at the root of optical coherence tomography, which is breaking barriers in ophthalmology, cardiology, and oral cancer detection (see "Better resolution with multibeam OCT," page 28) among other applications. He initiated the field known now as Optical Biopsy

He recently calculated he has brought in $62 million worth of funding to CUNY during his career, averaging $1.7 million per year. He states that he has accomplished this feat by "hitting the pavement"; he developed a habit of aggressively reaching out to funding partners and getting them interested in his work. Alfano has made discoveries that have furthered biomedical optics, in addition to fields such as optical communications, solid-state physics, and metrology. Alfano has an outstanding track record for achievements regarding the development of biomedical instruments. His contributions to photonics are documented in more than 700 research articles, 102 patents, several edited volumes and conference proceedings, and well over 10,000 citations. He holds 45 patents and published over 230 articles in the biomedical optics area alone. His discovery of the white-light supercontinuum laser is at the root of optical coherence tomography, which is breaking barriers in ophthalmology, cardiology, and oral cancer detection (see "Better resolution with multibeam OCT," page 28) among other applications. Alfano has trained and mentored over 52 PhD candidates and 50 post-doctoral students. For the past ten years, he has trained innumerable high school students in hands on photonics.

Areas of Expertise/Research

Bonding of Tissues with Light Biomedical Optics and Detection of Cancer with Light Spectroscopy Expertise in Properties of Light and Photonics Ultrafast Spectroscopy and Lasers Physics and Electrical Engineering Science and Engineering

International Scientific Conference on

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Micro FBG Sensor Systems for Aircraft Wing Drag Optimization

Alex Kazemi
ARK International LLC , Chairman LOPS 2021, Chief Scientific Committee Chair, Keynote Speaker, LOPS 2021

There is a great interest among aircraft manufactures to reduce fuel burn for new generation of airplanes. One important parameter to reduce fuel consumption is to improve aerodynamic efficiency. Micro FBG could improve fuel efficiency by mitigation of induced drag. The goal is to embedded micro FBG Sensing Network in the wing section of an aircraft, analysis and perform testing to meet the strict aviation standards and requirements. Due to immunity to electromagnetic interference (EMI), rapid response in real time, sensitivity and small size, FBG sensors have found many applications in structure health monitoring of aircrafts in past 20 years. The first fiber Bragg period gratings were successfully inscribed on an optical fiber in 1978. Since then, it is widely been used as temperature and strain measurements in aerospace applications.

In normal fiber, the refractive indices of the core and cladding do not change along the length of the fiber; however, by inducing a periodic modulation of refractive index along the length in the core of the optical fiber, the optical fiber grating is produced. This exhibits very interesting spectral properties and for this reason in this paper it is proposed to develop and integrate a distributed sensor network based on fiber Bragg gratings (FBGs) technology which has grating periods on the order of 100 μm to 1 mm to be embedded in the wing section of aircraft to measure bending and torsion in real-time in order to measure wing deformation of commercial airplanes resulting in extensive benefits such as reduced structural weight, mitigation of induced drag and lower fuel consumption which is fifty percent of total cost of operation for airline industry.

The main objective is to optimize the design for material, mechanical, optical and environmental requirements of using micro FBG sensors embedded in the wing section of aircraft. Detail discussion is illustrated for analysis and evaluation of FBG integration using WDM multiplexing, system performance, qualification testing for thermal cycling, aging, smoke, flammability, impact resistance, flexure endurance, tensile, vibration and shock.

Key Words: Aircraft, Aviation, Micro, Fiber Bragg Gratings (FBG), Sensor, Wing, Drag Optimization.

Biography

Dr. Alex Kazemi a world recognized Micro Technologist and materials scientist; he has developed leading edge technologies including at Boeing Commercial Airplanes the lightest fiber optic cable in aviation history, World 1st fiber optic sensor for rocket engine and U.S. 1st fiber optic delivery system for high-speed micro laser. He is focusing on development of state-of-the art new generation of fiber optics, miniaturized interconnects, fiber optic sensors, and micro packaging of laser components for aerospace applications. He is President and CEO of ARK International LLC, Boeing Associate Technical Fellow and has worked for 35 years. He is regarded as the leading expert in above areas by industry and academia, including U.S. and European aerospace agencies. At Boeing Defense and Space Systems, he has performed pioneering work for Boeing EELV by successfully demonstrating the world's 1st fiber optic hydrogen leak detection system during Delta IV rocket engine test at NASA/Stennis: Before beginning his career in industry, he spent several years teaching Physics and Materials Science at USC. Followed by 10 years working for telecommunications and fiber optic sensors/MEMS industry. He has authored/edited 8 books and one book chapter in the area of Photonics, Lasers, Sensors, Fiber Optics, Micro and Nano Technologies, plus published over 45 papers in International Journals and hundreds of presentations throughout of conferences and technical communities. His research publications have received 1000 ResearchGate Peers Recognition plus 100 times Citations. In November 2018 an International Award was presented to him for the best paper on breakthrough in laser development for space applications. He has been Chairman of SPIE International Conferences in Photonics Applications for 8 years and for the last two years Chairman as well as the Chief Editor of Excel Global International Conference on Lasers, Optics, Photonics, and Sensors. In 2020, he received 31 invitations to attend international conferences to present as chair/plenary/keynote/speaker at 26 international cities in 18 countries round the world plus 32 invitations to be Chief Editor/Editor and present papers in engineering and scientific publication worldwide. He has been bestowed hundreds of awards, recognitions and patents.

KEYNOTE SPEAKER

Quantum Science and Technology

Manijeh Razeghi
Walter P. Murphy Professor
Department of Electrical Engineering & Computer Science
Director, Center for Quantum Devices
Northwestern University, Evanston, IL 60208, Plenary Speaker
@ LOPS 2021

PLENARY SPEAKER

Recent understanding of Quantum Science and Technology has exceeded our expectations for meeting the requirements of human society for different applications, such as telemedicine, in the 21st century. Free-space optical (FSO) communication is considered to be one of the key technologies for realizing ultra-high-speed multi-gigabit-per-second (multi-Gb/s) large-capacity communications. Using lasers as signal carriers, FSO laser communications (Laser-Com) can provide a line-of-sight, wireless, high-bandwidth, communication link between remote sites. Rapidly growing use of the Internet and multimedia services has created congestion in the telecommunications networks and placed many new requirements on carriers. IR Laser transmitters offer an intermediate low-risk means to introduce desired network functionalities with extremely high bandwidth. The wireless aspect of FSO Laser-Com can be a crucial advantage, particularly in local area networks (LANs) and metropolitan area networks (MANs) where in cities the laying of optical fibers is expensive. FSO Laser-Com offers substantial advantages over conventional RF wireless communications technology, including higher data rates, low probability of intercept, low power requirements, and much smaller packaging. FSO Laser-Com systems have proven to be a viable alternative to optical fiber based systems in several applications, as the technology comes closer and closer to providing the 5-nines (99.999%) service that many different types users require of their data networks.

Nature offers us a full assortment of atoms, but Quantum engineering is required to put them together in an elegant way to realize functional structures not found in nature. A particular rich playground for Quantum era, is the so-called III-V semiconductors, made of atoms from columns III and V of the periodic table, and constituting compounds with many useful optical and electronic properties in their own right. Guided by highly accurate simulations of the electronic structure, modern semiconductor quantum devices are literally made atom by atom using advanced growth technology to combine these materials in ways to give them new proprieties that neither material has on its own. Modern mastery of atomic engineering, allows high-power and highly efficient functional devices to be made, such as those that convert electrical energy into coherent light or detect light of any wavelength and convert it into an electrical signal.

This talk will present the future trends and latest world-class research breakthroughs that have brought quantum engineering to an unprecedented level, creating light detectors and emitters over an extremely wide spectral range from deep -UV).2 to THZ 300 microns. As well as their integration with Si photonics.

Biography

Manijeh Razeghi is the Walter P. Murphy Professor of Electrical Engineering at Northwestern University and Director of the Center for Quantum Devices, which she founded in 1991 after a successful 10-year career as the Director of Exploratory Materials at Thomson-CSF, France. She is one of the leading scientists in the field of semiconductor science and technology, having pioneered the development and implementation of major modern epitaxial techniques. Her current research interest is in nanoscale optoelectronic quantum devices from deep-UV up to terahertz. At Northwestern University she has commercialized aluminum-free pump lasers, developed type-II superlattices for next generation infrared imagers (an area in which she holds key patents), and currently holds most of the quantum cascade lasers records for high power and tunability. She has authored 18 books, 31 books chapters, and more than 1000 journal publications. She is editor, associate, and board member of many journals, including Nano Science and Nano technology. Her awards include the IBM Europe Science and Technology Prize, the SWE Lifetime Achievement Award, the R.F. Bunshah Award, the IBM faculty award, Jan Czochralski Gold Medal, and many best paper awards. She is a fellow of SWE, SPIE, IEC, OSA, APS, IOP, IEEE, and MRS.

Long-range, hysteresis-free and fast optical hydrogen sensing using transition metal hydrides

Bernard Dam

Head, MECS (Materials for Energy Conversion and Storage), Delft University of Technology, Netherlands, Session-Chair, LOPS 2021

KEYNOTE SPEAKER

Thin film metal hydride based optical hydrogen sensors provide an attractive option to sense hydrogen in a variety of conditions and have an attractive safety benefit over other methods of detection: They do not require the presence of electrical leads near the sensing area. These sensors rely on a change of the optical properties arising from a change in the hydrogenation of the metal hydride sensing layer in response to a different partial hydrogen pressure in the environment of the sensor. Often Pd-alloys are being used for this, since this material displays an optical change and is able to catalyse the hydrogen sorption. By using Pd-capped transition metals we split the catalytic and the sensing action which allows us to optimize both the kinetics, the optical contrast and the sensing range of the material. We demonstrate that Pd-capped Hf and Ta based thin films provide excellent opportunities to create sensors with a wide sensing range. In particular, $Ta_{1-y}Pd_y$ alloys allow for an extremely wide sensing range of at least seven orders of magnitude in hydrogen pressure. Nanoconfinement of the $Ta_{1-y}Pd_y$ layer suppresses the first-order phase transitions present in bulk and ensures a sensing response free of any hysteresis within a single thermodynamic phase. Unlike other sensing materials, $Ta_{1-y}Pd_y$ features the special property that the sensing range can be easily tuned by varying the Pd concentration without a reduction of the sensitivity of the sensing material. Combined with a suitable capping layer, sub-second response times can be achieved even at room temperature, faster than any other known thin-film hydrogen sensor.

Biography

Bernard Dam is a Dutch physical chemist who started his career with a thesis on the growth and morphology of incommensurately modulated crystals. After working as a researcher Philips Research Labs in Eindhoven on High-Tc superconductors and as an Associate Condensed Matter Professor at the VU University in Amsterdam, he is now the head of the MECS (Materials for Energy Conversion and Storage) group at the Delft University of Technology. In addition he is co-chair of the e-Refinery institute on electrochemical conversion. His present research ranges from in the investigation of metal oxyhydrides for photochromic and battery applications to the application of metal hydrides as optical fiber hydrogen sensors. The latter research shows the possibility to develop optical hydrogen sensors spanning six orders of magnitude in pressure.

Syed H. Murshid
The Inventor of SDM & OAM in Optical Fibers,
Florida Institute of Technology, USA,
Session Chair, LOPS 2021

KEYNOTE SPEAKER

High-speed optical fiber communications architecture combining SDM and OAM based designs with PAM4 and WDM systems.

Increasing total channel capacity in optical fiber communications and networking requires new approaches for transmission media. Optical communication system data rates can be substantially improved through new modulation and multiplexing techniques. Spatial domain multiplexing (SDM), also known as space-division multiplexing, can increase the bandwidth and spectral efficiency of optical fibers by order of magnitude or higher. It can support multiple channels of the same wavelength over a single fiber, where each channel follows a unique helical path inside the fiber core, and the channels do not interfere with each other. It is a multiple-input multipleoutput (MIMO) architecture that launches light from multiple laser sources of the same wavelength into a single carrier fiber at different angles. The resultant channels follow different helical trajectories while traversing the carrier fiber, thereby allowing spatial reuse of optical frequencies. The input launch angles determine the output's spatial characteristics by allocating a unique location to each channel. Each channel's energy density follows a different radial distribution, and adjacent channels do not exhibit any discernible crosstalk. Simple spatial filtering techniques are employed at the output end of the fiber to de-multiplex these channels. Helically propagating SDM channels also carry orbital angular momentum (OAM) of photons. Hence, clockwise and counter-clockwise OAMs can be independently generated. SDM and OAM add two new degrees of photon freedom to optical fiber multiplexing techniques and can complement existing multiplexing and modulation schemes, such as TDM, WDM/DWDM, and PAM4 achieve high-speed serial optical data transport. This endeavor presents a hybrid MIMO architecture that combines SDM and OAM over a single-core multimode carrier fiber. It also shows that the radial location of a given SDM channel output is independent of the light source's wavelength, thereby allowing integration of SDM and OAM based multiplexing techniques to WDM/DWDM networks. It also presents a Multi-Tb/s high-speed optical fiber communication architecture that combines spatial domain multiplexing and orbital angular momentum of photon-based multiplexing and complements wavelength division multiplexing as well as PAM4 modulation.

Keywords: Spatial domain multiplexing (SDM), space division multiplexing (SDM), orbital angular momentum (OAM), optical vortex, helical propagation, bandwidth increment, optical fiber communications, optical architecture, Multi Tb/s optical communications.

Biography

Syed H. Murshid is a Professor of Electrical and Computer Engineering at the Florida Institute of Technology in Melbourne, Florida. He teaches courses in optics and electrical engineering at both graduate and undergraduate levels. His research focuses on optical fiber communications and sensors. He is pushing the state-of-the-art in optical fiber bandwidth using hybrid optical architectures, and his contributions include adding two new degrees of photon freedom to optical fiber multiplexing techniques. As the inventor of SDM and OAM in optical fibers, he holds multiple patents to these technologies. His current research activities are focused on combining these technologies for communication architectures exceeding 100s of Tb/s.

Professor Murshid is an active researcher, and his endeavors regularly receive support from the government and industry. He disseminates his research results regularly in books, book chapters, peer-reviewed articles, and conference presentations. He also holds ten US and International patents. In November 2004, he was named one of Florida's five most influential scientists by the Florida Trend Magazine.

Murshid received BE in Electronics Engineering in 1986 from NED University of Engineering and Technology in Karachi and served the instrumentation and process industry until 1994 in different capacities that focused on design and maintenance of SCADA systems. He received MS in Electrical Engineering from the Florida Institute of Technology in 1995, followed by Ph.D. in Electrical Engineering in 1997. After a brief sojourn with Harbor Branch Oceanographic Research Institute, he returned to Florida Tech in 1999, where he currently teaches courses in electrical circuits, virtual instrumentation, photonics, fiber-optic communications, and fiber-optic sensors

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Edgar A. Mendoza
Redondo Optics Inc. United States
Session Chair, LOPS 2021

KEYNOTE SPEAKER

Wearable Personal Point-of-Care Multi-Parameter Vital-Sign Physiology Optical Sensing Monitor (VISIOM™) System

The goal of this work is the development, testing, and demonstration of a unique cost affordable, autonomous, non-invasive, safe, reliable, and easily wearable personal point-of-care multi-parameter, vitalsign physiology optical sensing monitor (VISIOM™) system based on the use of wearable "SmartPhysiology" garments – underwear, knit shirts, pants, lined jackets, sleep shorts, sports-wear, sacks, and others – that seamlessly integrate a multiplex distributed array of fiber optic sensors weaved within the wearable garment fabrics suitable for the real-time, in-situ un-intrusive monitoring of basic biomechanical and biochemical physiological parameters such as body movement and shock, temperature, bloodpressure, respiration rate, hearth rhythm, blood oxygenation, CO2 level, hydration level, sweat constituents (pH, salts, minerals, glucose, lactose, insulin), among many others. The end result of the VISIOM™ "SmartPhysiology" development and demonstration program will result in the production of wearable "Smart" vitalsign sensing garments no different from common personal wardrobes but with the added benefit of enabling autonomous and seamless real time monitoring of the user's physiology health state. The Covid-19 pandemic has had a staggering effect on personal care. Today's Covid's virus exposure to the world population has created a critical need for point-of-care personal-health vital-sign physiological condition monitoring is highly desirable.

Biography

Dr. Ed Mendoza leads the technology and business strategy vision for Redondo Optics, with over thirty years of experience as a senior executive, strategic business development, and technology innovation in fast-growth star-up companies focus on emerging markets in aviation & aerospace, smart structures, renewable energy, life sciences, oil & gas, and defense and security. Ed received his Ph.D. from the City University of New York. Currently works in fields ranging from fiber optics sensors, silicon photonics, smart wearable fabrics, optical metrology, remote sensing, Lab-on-Chip opto-fluidics, diffractive and refractive optics, and nanomaterials.

Plasmonic micro sensor for pesticides detection

Nicolas Javahiraly
University of Strasbourg, France
Session Chair, LOPS 2021

Micro pollutants are substances found in trace amounts in water, air and soil. Generally toxic, they can be of all kinds: mineral, organic or biological. We will focus here on a specific class of micro pollutant: pesticides. On March 20, 2015, the World Health Organization's cancer agency classified five pesticides as "possible" or "probable" human carcinogens. Among these five pesticides is glyphosate, which is the most widely used pesticide in the world.

Furthermore, the detection of micro pollutants by new innovative systems is one of the important issues of our society. This study is dedicated to innovative pollutant micro sensors exploiting the interaction properties between light and original nanostructured materials, in order to create a real jump in performance in terms of detection limit, quantification and sensitivity. The detection of our pesticide is based on the variation of the optical properties of the materials used in the presence of the molecule to be detected. We propose two ways of investigation that are (i) the Surface Plasmon Resonance detection (SPR) in Kretschmann configuration and (ii) the use of an original functionalized nano-structured organization based on the use of functionalized gold nanoparticles.

Keywords: Plasmonics, Micro pollutant detection, Nano structured materials.

Biography

Nicolas Javahiraly is an associate professor in physics at the University of Strasbourg. He did his PhD in Photonics at the same university on fiber optic sensors. After a post-doc at Harvard University on the interaction between ultra-short laser pulses and matter, he worked as a project manager and expert in the Sagem Defense group in Paris. He joined the University of Strasbourg in 2007 and is currently working on nano-optical sensors and plasmonics for various applications such as gas detection, pollutants detection and photoconversion systems for example.

KEYNOTE SPEAKER

A traffic light diagnostic inspired by neuromorphic system.

Sendy Phang
George Green Institute for Electromagnetics Research, UK
University of Nottingham, UK

Neuroscience has found that humans' instantaneous capability of perceiving colours is not only because of a simple sensing process but also as the result of "decision making process". While the first process relies only on the unique colour-dependent receptor in the retina, the latter process involves with how the optical-nerve signal is process throughout its "chaotic" journey from the retina to the brain. Recently, a new paradigm in Artificial Neural Network (ANN) called Reservoir Computer (RC) has been reported. The RC, unlike other kind of ANN approaches, embraces chaotic signal propagation in its kernel layer and feedback system in its read-out layer, mimicking how brain process information.

In this talk, we propose a real-time diagnostic tool inspired by the RC. We will show a possible route of implementing such RNN as an integrated photonic system to perform a bespoke discrimination task. The discrimination is achieved by recognising the unique temporal signal signature arising from the chaotic photonic kernel in the presence of different analyte. This is noted that the new discrimination approach reported is performed directly on the temporal signal, in contrast to the conventional spectral fingerprinting.

Biography

Sendy Phang is an assistant professor in electromagnetics engineering in the George Green Institute for Electromagnetics Research, The University of Nottingham, UK since 2019. He received the BEng (with honours) in engineering physics from the Bandung Institute of Technology, Bandung, Indonesia, in 2010, the MSc in electromagnetic and the PhD in electrical and electronic engineering from the University of Nottingham, UK, in 2011 and 2016, respectively. He was the recipients of the 2017 Young Scientist Award presented by the URSI General Assembly. His recent research interests are in ultrafast optical sensing enabled by an all-optical information processing device based on metamaterial, parity-time quantum-mechanics and neuromorphic systems.

KEYNOTE SPEAKER

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Sergio Fantini
Tufts University, United States
Co Chair, LOPS 2021

KEYNOTE SPEAKER

Dual slopes in diffuse optics

Slope methods based on data collection at multiple source-detector separations have been widely used in the field of diffuse optics, especially in continuous-wave (CW) and frequency-domain (FD) near-infrared spectroscopy (NIRS). These slope techniques are typically based on a single source (and multiple detectors) or a single detector (and multiple sources), in which case they may be termed "single-slope" methods. Single-slope measurements are largely insensitive to instrumental and optical coupling effects associated with the single element. In the late 1990's, a dual-slope approach, identified as "self-calibrating," was introduced to perform slope measurements that are insensitive to instrumental and coupling effects associated with both sources and detectors, resulting in calibration-free measurements of the optical properties of highly scattering media. The source-detector arrangement of this self-calibrating approach was adopted by research groups and tissue oximetry companies to achieve robust measurements of the effective attenuation coefficient (with CW-NIRS) or the absorption and reduced scattering coefficients (with FD-NIRS) of highly scattering media such as biological tissue. Recently, dual-slope measurements, especially those based on the phase of photon-density waves in FD-NIRS or the mean photon time-of-flight in TD-NIRS, were shown to feature the additional property of being selectively sensitive to deeper layers of the sample, which is desirable in non-invasive biomedical applications that target deeper tissue (brain, skeletal muscle, etc.). In this presentation, we will review slope methods, and we will report latest developments in our group for the characterization and advancement of dual-slope methods. In particular, we will demonstrate the insensitivity of dual slopes on instrumental factors associated with both sources and detectors, describe the measurement of absorption changes using either intensity dual slopes (in CWNIRS) or phase dual slopes (in FD-NIRS), illustrate the regions of sensitivity of dual slopes in homogeneous and inhomogeneous media, discuss considerations for the design of source-detector arrays for dual-slope imaging, and report initial in vivo dual-slope measurements in human subjects for broadband spectroscopy, spatial mapping of tissue hemodynamics, and time-frequency characterization of oscillatory hemodynamics. Dual-slope measurements feature desirable aspects of practical and conceptual significance that can help advance a number of spectroscopy and imaging applications in the field of diffuse optics.

Biography

Sergio Fantini received his doctoral degree in physics from the University of Florence, Italy, in 1992. His dissertation was based on a Raman scattering study of ceramic superconductors. From 1993 to 1999, Fantini held postdoctoral and faculty appointments at the University of Illinois at Urbana-Champaign, in the Department of Physics. In 1999, he joined Tufts University as an assistant professor and has been one of the inaugural faculty members of the Department of Biomedical Engineering, which was created at Tufts in 2002.

Andrei Afanasev
The George Washington University,
United States

KEYNOTE SPEAKER

Novel Propagation Modes of Twisted Light in Spatially Dispersive Matter

Polarization of matter induced by electromagnetic fields may have two kinds of dispersion: (a) frequency dispersion and (b) spatial dispersion. The former results in a well-known frequency-dependent refractive index of materials, while the latter leads to dependence on light's wave vector, or spatial derivatives of the fields (in position space) and leads to effects like optical activity. The reason behind spatial dispersion is in non-local relation between the applied fields and resulting polarization of dielectric matter. We analyze effects of spatial dispersion on propagation of structured light waves and demonstrate possible new effects. In particular, we show that phase singularities effectively change the refractive index across the transverse beam profile, leading to dichroic effects and possibly novel propagation modes.

Biography

Andrei Afanasev currently leads the physics effort for the GWU energy initiative. He has made significant research contributions in the field of nuclear and particle physics probed with high-power electron accelerators and free-electron lasers.

Presently Prof. Afanasev contributes to energy research in three areas: (a) High-power particle accelerators that may serve as drivers for accelerator-driven subcritical nuclear reactors (ADSR), as well as probes of new materials for energy applications; (b) Development of novel techniques in photovoltaics, including nanostructures, quantum dots, and surface acoustic waves; (c) New technologies for non-proliferation of nuclear materials.

Prof. Afanasev is the Director of the Photoemission Research Laboratory where new solutions for particle accelerator sources and photovoltaics are being developed and tested.

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Robust, Field-deployed Laser Modules For Next Generation Quantum Sensors

Kevin Knabe[1*], Henry Timmers[1], Andrew Attar1, Bennett Sodergren1, Dylan Tooley1, and Kurt Vogel[1]
[1]Vescent Photonics, United States

KEYNOTE SPEAKER

Next-generation quantum sensors are constrained to laboratory settings due to the low maturity, large size, and/or high electrical power consumption of lasers and physics packages. Over the last 5 years, Vescent Photonics has been developing, integrating, and testing small, field-deployable lasers suitable for quantum sensing applications. The first laser system that will be discussed is a heterodyne agile laser (HAL) system that contains two DBR lasers, a Rb spectroscopy cell, and necessary electronics for laser stabilization and control. The HAL system capabilities will be discussed, and applications such as cold-atom clocks and atom interferometers will be mentioned. The second laser system that will be discussed is the FFC-100, our commercial fiber frequency comb. This rack-mount unit offers turn-key operation that can support high-performance optical atomic clocks, dual comb spectroscopy, optical frequency generation, low phase-noise microwave generation, and many other comb applications. Based on the government funding supporting this work, we have developed deployable optics modules that have volumes less than 1 liter and require less than 20 W to operate. The performance and size of these optics modules will be summarized and future performance improvements and size and power reductions will be discussed.

Biography

Dr. Knabe has extensive experience with laser stabilization and precision optical measurements including saturated absorption spectroscopy in hollow-core photonic crystal fibers (under Dr. Kristan Corwin at Kansas State University), comb-assisted spectroscopy using a quantum cascade laser in the mid-IR for rapid broadband spectroscopy (under Dr. Nathan Newbury at NIST), and stabilization of a wide range of laser sources to high finesse optical cavities to produce lasers that have sub-Hertz linewidths (at Stable Laser Systems). As Director of Research and Development at Vescent Photonics he oversees both commercial and government funded projects related nextgeneration quantum sensors

Linda Olafsen
Baylor University, United States
2018: Outstanding Faculty Award
Chair, Congressional Visits Day subcommittee

Optical Pumping and Reduction of Droop in Interband Cascade Lasers

Lasers comprised of antimonide-based semiconductor materials are designed to emit efficiently in the 3–6 micrometer wavelength range, an atmospheric transmission window that is eye safe and in which chemical sensitivities are 100–10,000 times better than at shorter wavelengths. In particular, the interband cascade laser employs repeated stages to yield multiple photons per injected electron, as compared with a single photon per injected electron in conventional quantum well lasers. However, even with the significant advances achieved utilizing wave function engineering in these semiconductor heterostructures, declining efficiency with increasing current (droop) at high temperatures limits the power output of these lasers. Optical pumping has been used to demonstrate lasing in interband cascade lasers, and this excitation technique is being applied to isolate efficiency limiting mechanisms and subsequently improve future laser designs. Integration of graphene layers with high electrical, optical, and thermal conductivity on gallium antimonide semiconductor surfaces also will be presented, with the goal of applying these transparent contact layers to further enhance efficiency, as well as to provide a deeper understanding of the integration of 2D and 3D materials.

Biography

Linda Olafsen earned an A.B. in Physics at Princeton University. She then went to graduate school in Physics at Duke University and received her Master's degree in 1994 and her Ph.D. in 1997. Dr. Olafsen accepted a National Research Council postdoctoral research associateship at Naval Research Laboratory in Washington, D.C. for two years before taking a faculty position at the University of Kansas in 1999, first as an Assistant Professor, receiving an Office of Naval Research Young Investigator Award in 2001, and being promoted to Associate Professor in 2005. She joined the faculty at Baylor University as an Associate Professor of Physics in 2006, and then as an Associate Professor of Electrical and Computer Engineering in 2015. She was recognized in 2018 with an Outstanding Faculty Award for Teaching at Baylor University. She is a member of the IEEE (senior member), SPIE, the American Physical Society (lifetime member), the Directed Energy Professional Society, and the Materials Research Society. She is on the editorial board of the MRS Bulletin, chairs the MRS Bulletin book review board, and has served as a member and chair of the Congressional Visits Day subcommittee, organizing visits to Washington, DC to speak with members of Congress about the impact of federal funding of research. Her research is focused on the development of efficient mid-infrared semiconductor lasers at or above room temperature, as well as the application of materials and infrared sensing to biomedical devices and system

KEYNOTE SPEAKER

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

MicroLEDs and OLEDs for Non-Display Applications

Ioannis (John) Kymissis
Kenneth Brayer Professor of Electrical Engineering
Chair, Department of Electrical Engineering, Columbia University, United States

The majority of applications for organic light emitting diodes (OLEDs) and micro light-emitting diodes (µLEDs) have achieved their goal as displays once light is emitted. There are a variety of applications, however, in which the emitted light can further be used to probe or sense. In this talk, I will highlight a number of recent non-display applications for µLEDs before looking forward to other possibilities in bio sensing and electronic applications in the future.

Biography

Ioannis (John) Kymissis is the Kenneth Brayer Professor of Electrical Engineering at Columbia University. John graduated with his SB, M.Eng., and Ph.D. degrees from MIT. His M.Eng. thesis was performed as a co-op at the IBM TJ Watson Research Lab on organic thin film transistors, and his Ph.D. was obtained in the Microsystems Technology Lab at MIT working on field emission displays. After graduation he spent three years as a post-doc in MIT's Laboratory for Organic Optics and Electronics working on a variety of organic electronic devices and as a consulting engineer for QDVision (since acquired by Samsung). He joined the faculty at Columbia University in Electrical Engineering in 2006 as an assistant professor. John has won a number of awards for his work, including the NSF CAREER award, the IEEE EDS Paul Rappaport award, the Voda phone Americas Foundation Wireless Innovation Award, the MIT Clean Energy Prize, and a Verizon Powerful Answers award. He served a term as the editor in chief of the Journal of the Society for Information Display, is a fellow of the SID, serves as the SID treasurer, and was the general chair for the 2014 Device Research Conference.

KEYNOTE SPEAKER

Frontier in Optical Coherence Tomography: Doppler OCT, OCTA, and Optical Coherence Elastography

Zhongping Chen
Beckman Laser Institute, Department of Biomedical Engineering
University of California Irvine,
United States

KEYNOTE SPEAKER

Doppler OCT, a technology that we developed almost 25 years ago, is one of the fastest growing areas of biomedical optics with many potential clinical applications. I will describe the latest advances in Doppler OCT and OCT angiography. In addition, I will report the development of an acoustic radiation force optical coherence elastography (ARF-OCE) technology to characterize tissues biomechanical properties based on Doppler OCT. Knowledge of tissue mechanical properties provides valuable medical information in disease diagnosis and prognosis. There is a close correlation between tissue elasticity and pathology. We recently demonstrated, to the best of our knowledge, the first in vivo OCE imaging of retina and lens in animal model. The ARF-OCE technology will have a broad range of clinical applications, including imaging and evaluating ophthalmic diseases such as keratoconus, myopia, presbyopia, age-related macular degeneration, and glaucoma. The challenges and opportunities in translational this technology for clinical application in ophthalmology will be discussed.

Biography

Dr. Zhongping Chen is a Professor of Biomedical Engineering and Director of the OCT Laboratory at the University of California, Irvine. He is a Co-founder and Chairman of OCT Medical Imaging Inc. Dr. Chen received his B.S. degree in Applied Physics from Shanghai Jiao Tong University in 1982, his M. S. degree in Electrical Engineering in 1987, and his Ph.D. degree in Applied Physics from Cornell University in 1993.

Dr. Chen and his research group have pioneered the development of Doppler optical coherence tomography, which simultaneously provides high resolution 3-D images of tissue structure and vascular flow dynamics. These functional extensions of OCT offer contrast enhancements and provide mapping of many clinically important parameters. In addition, his group has developed a number of endoscopic and intravascular rotational and linear miniature probes for OCT and MPM imaging and translated this technology to clinical applications. He has published more than 300 peer-reviewed papers and review articles and holds a number of patents in the fields of biomaterials, biosensors, and biomedical imaging.

Dr. Chen is a Fellow of the American Institute of Medical and Biological Engineering (AIMBE), a Fellow of SPIE, and a Fellow of the Optical Society of America.

Semiconductor Optical Amplifiers for Optical logic Applications

Niloy K.Dutta
University of Connecticut, United States

All-optical Boolean logic functions AND, XOR and NOT using semiconductor optical amplifiers with quantum-dot (QD) active layers is studied at 40 and 80Gb/s. A rate equation model has been developed which includes nonlinear dynamics including carrier heating, spectral hole-burning, and carrier relaxation. Results show that the QD excited state and wetting layer serve as reservoir of carriers, and, the ultra fast carrier relaxation from these layers, results in high speed Boolean logic operations. Logic operation can be carried out up to speed of 250 Gb/s. Pseudo-random bit stream generation (PRBS) and optical encryption and decryption circuits has been studied.

Biography

Niloy Dutta is a professor of physics at the University of Connecticut, Storrs, CT. He was Director of Optoelectronic Device Research at AT&T Bell Laboratories, Murray Hill, NJ. He is a Life Fellow of the Institute of Electrical Engineers (IEEE), a Fellow of the Optical Society of America, a Fellow of the International Society of Optical Engineers (SPIE), and, a Member of the Connecticut Academy of Science and Engineering. He received the Photonics Society Distinguished Lecturer Award in 1995 and Bell Laboratories President's Award in 1997.

KEYNOTE SPEAKER

Diffuse optical spectroscopy-based biomarkers of cerebral health

Jana Kainerstorfer, PhD
Carnegie Mellon University, United States

KEYNOTE SPEAKER

Bedside monitoring of tissue perfusion is important for a variety of diseases. For cerebral monitoring, cerebral perfusion is important especially for traumatic brain injury, hydrocephalus, sepsis, and stroke, where inadequate perfusion can lead to ischemia and neuronal damage. Diffuse optical methods, such as near-infrared spectroscopy and diffuse correlation spectroscopy, are non-invasive optical techniques which can be used to measure cerebral changes at the bedside. This talk will focus on these optical techniques as applied to clinical measurements to monitor patients and predict treatment outcome. One example of such will be presented which is our recent developments of a non-invasive intracranial pressure (ICP) sensor. For this we have developed an animal model of hydrocephalus, where ICP could be controlled and manipulated. Using diffuse correlation spectroscopy to measure cerebral microvascular blood flow, we developed an algorithm which translates cardiac pulses in blood flow into ICP. Our results show that ICP could be extracted to within ~4 mmHg, making this a clinically useful tool with the opportunity to replace invasive ICP sensors. This talk will summarize our optical imaging methods, experimental procedures, and results, as well as the path towards clinical translation.

Biography

Jana Kainerstorfer is an Associate Professor of Biomedical Engineering at Carnegie Mellon University and holds courtesy appointments in the Neuroscience Institute and Electrical & Computer Engineering. Her lab's research is focused on developing noninvasive optical imaging methods for disease detection and/or treatment monitoring, with an emphasis on diffuse optical imaging. She serves on program committees at national and international conferences (including the SPIE Photonics West as well as OSA Topical Meetings) and served as Program Chair for the OSA Biophotonics Congress: Optical Tomography and Spectroscopy in 2020. She further is an associate editor for Journal of Biomedical Optics (SPIE), served as associated editor for IEEE Transactions on Biomedical Engineering, as a guest editor for Opportunities in Neurophotonics in APL Photonics, and as editor for the Virtual Journal of Biomedical Optics (a journal of the Optical Society of America). She got elected as a senior member of the Optical Society of America. Her research has been funded by AHA, NIH, ONR, DARPA, and the Air Force, including the NIH R21 Trailblazer as well as AHA Scientist Development Grant.

Ophthalmic polarization-sensitive diagnostic technologies employing retinal birefringence scanning

Retinal birefringence scanning (RBS) has recently been used to detect central fixation and proper eye alignment in ophthalmic diagnostics. It utilizes the property of the Henle fibers surrounding the human fovea to change the polarization state of light in a double-pass polarization-sensitive optical system. This principle has been employed in a series of vision screeners developed in our lab. They allow eye tracking and detection of central fixation using anatomical information directly from the fovea and without calibration, unlike other eye tracking methods that employ less accurate pupillary light reflex methods. In a binocular setting, RBS facilitates precise checking for eye alignment. These instruments have proven to be valuable in early detection of amblyopia and strabismus. Such systems are particularly useful when working with young children. The presentation focuses on a family of pediatric vision screeners and includes design optimization using a computer model of polarization-sensitive systems.

The usage can be expanded to add a fixation detection function to other ophthalmic technologies, such as laser-doppler flowmetry, fundus cameras, OCT devices, etc. As an example, a hybrid system integrating optical coherence tomography and retinal birefringence scanning is presented. It acquires and/or analyzes data only during moments of central fixation. This can significantly reduce the image processing time, and shorten the exam duration. Methods to attract the subject's attention and ensure fixation are also discussed.

Special attention is paid to possible implementation of no-moving-part technologies, liquid crystal technologies, and clinical testing. Related topics will be discussed, such as automatic detection and correction of ocular defocus in vision screening, laser safety, decision making logic, and others.

The talk will be interesting to ophthalmologists, optometrists, medical students, biomedical engineers and physicists, as well as health care managers and general practitioners.

Gramatikov
Ophthalmic Instrumentation Development Laboratory
Wilmer Eye Institute
The Johns Hopkins University School of Medicine
Baltimore, Maryland, United States

KEYNOTE SPEAKER

Biography

Boris Gramatikov obtained his Dipl.-Ing. degree in Biomedical Engineering in Germany, and his Ph.D. in Bulgaria. He has completed a number of postdoctoral studies in Germany, Italy and the United States. He joined the faculty of the Biomedical Engineering Department of The Johns Hopkins University in 1996, and has been working in the Laboratory of Ophthalmic Instrumentation Development at The Wilmer Eye Institute since 2000. His areas of expertise include electronics, optoelectronics, computers, computer modeling, signal/image processing, data analysis, instrumentation design, biophotonics, ophthalmic and biomedical optics, polarization optics, all applied to the development of diagnostic methods and devices for ophthalmology and vision research. His team has developed a series of pediatric vision screeners. He has over 120 publications, 41 of which in high-impact peer-reviewed journals. He serves as a reviewer and editorial board member with a number of technical and medical journals.

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

June 12-14 2021 | Webinar

DAY 2

https://lopsconference.com/speakers.php

Francesco Poletti
University of Southampton, UK

KEYNOTE SPEAKER

Hollow core Fibres: Sensing, Machining and communicating with air-guided light

The latest generation of hollow core fibres outperforms conventional all-solid fibre technology in many aspects. We will review the technology, its latest records and applications, and forecast what might be possible in a few years' time.

Biography

Professor Francesco Poletti heads the Hollow Core Fibre group at the Optoelectronics Research Centre (University of Southampton), an interdisciplinary team developing ground-breaking air-guiding fibres. For the past decade the team has been at the forefront in pushing the research boundaries of optical fibre technologies. Professor Poletti holds an ERC consolidator grant and is a co-founder of the startup Lumenisity, which commercialises air-guiding optical fibre cables for data communications.

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Customer-Affordable Handheld Near-Infrared Spectrometers: On-Site Quality Control and Protection against Product Counterfeiting

Heinz W. Siesler
Department of Physical Chemistry,
University of Duisburg-Essen, Germany

KEYNOTE SPEAKER

Recently, miniaturization of Raman, mid-infrared (MIR) and near infrared (NIR) spectro-meters has made substantial progress, and marketing companies predict this segment of instrumentation will have a significant growth rate within the next few years. This increase will launch vibrational spectroscopy into a new era of quality control by in-the-field and on-site analysis.

While the weight of the majority of handheld Raman and MIR spectrometers is still in the ~1 kg range, the miniaturization of NIR spectrometers has advanced down to the ~100 g level, and developments are under way to integrate them into mobile phones. Thus, based on high-volume manufacturability and significant reduction of costs, numerous companies target primarily with NIR instruments a non-expert user community for consumer applica-tions. Especially from this last-mentioned development, a tremendous potential for everyday life can be expected ranging from food testing to detection of fraud and adulteration in a broad area of materials (pharmaceuticals, textiles, polymers, etc.).

However, contrary to the exaggerated claims of many direct-to-consumer companies that advertise their ‘scanners’ with ‘cloud evaluation of big data’ this presentation will provide an overview on the realistic application potential of these instruments.

Biography

Heinz Wilhelm Siesler is a Professor of Physical Chemistry at the University of Duisburg-Essen, Germany, with expertise in vibrational spectroscopy in combination with chemometric data evaluation for chemical research, analysis and process control. He has 240+ publications (4 monographs) and presented more than 300 lectures worldwide. Since 2012 he is a Fellow of the Society for Applied Spectroscopy and received several awards (1994 EAS NIR Award, 2000 Tomas Hirschfeld PITTCON NIR Award, and 2003 Buechi NIR Award).

Prior to his academic position he gained industrial experience as section head in molecular spectroscopy and thermal analysis in the R&D Department of Bayer AG, Germany. He also worked as lecturer (University of the Witwatersrand, Johannesburg, South Africa) and Post-Doc (University of Cologne, Germany), after receiving his PhD in Chemistry (University of Vienna, Austria).

The test and application of miniaturized handheld vibrational spectrometers is a special research focus over the last ten years.

Ultrafast Photonics Techniques and Applications - Communication and Signal Processing at the Speed of Light-

The development of high speed communication, interconnects and signal processing are critical for an information based economy. Lightwave technologies offer the promise of high bandwidth connectivity from component development that is manufacturable, cost effective, and electrically efficient. The concept of optical frequency/wavelength division multiplexing, i.e., using many different laser colors for transmitting information, has revolutionized methods of optical communication; however the development of optical systems using 100's of wavelengths present challenges for network planners. The development of compact, efficient optical sources capable of generating a multiplicity of optical frequencies/wavelength channels from a single device could potentially simplify the operation and management of high capacity optical interconnects and links. Over the years, we have been developing "mode-locked" semiconductor lasers to emit ultrashort optical pulses at high pulse repetition frequencies for a wide variety of applications, but geared toward optical communication using time division multiplexed optical links. The periodic nature of optical pulse generation from mode-locked semiconductor diode lasers also make these devices ideal candidates for the generation of a multiplicity of high quality optical wavelengths, or "optical frequency combs", in addition to the temporally stable, high peak intensity optical pulses that one is accustomed to. These optical frequency combs enable a variety of optical communication and signal processing applications that can exploit the large bandwidth and speed that ultrafast optical pulse generation implies, however the aggregate speed and bandwidth can be achieved by spectrally channelizing the bandwidth, and utilize lower speed electronics for control of the individual spectral components of the mode-locked laser. This presentation will highlight our recent results in the generation of stabilized frequency combs, and in developing approaches for filtering, modulating and detecting individual comb components. We then show how these technologies can be applied in signal processing applications such as arbitrary waveform generation, arbitrary waveform measurement, laser radar and matched filtering for pattern recognition.

Peter J. Delfyett
CREOL, The College of Optics & Photonics
University of Central Florida, United States
Session Co Chair

KEYNOTE SPEAKER

Biography

Peter J. Delfyett received the B.E.(E.E.) degree from The City College of New York in 1981, the M.S. degree in EE from The University of Rochester in 1983, the M. Phil and Ph.D. degrees from The Graduate School & University Center of the City University of New York in 1987 and 1988, respectively. His Ph.D. thesis was focused on developing a real time ultrafast spectroscopic probe to study molecular and phonon dynamics in condensed matter using optical phase conjugation techniques. After obtaining the Ph.D. degree, he joined Bell Communication Research as a Member of the Technical Staff, where he concentrated his efforts towards generating ultrafast high power optical pulses from semiconductor diode lasers, for applications in applied photonic networks. Some of his technical accomplishments were the development of the world's fastest, most powerful modelocked semiconductor laser diode, the demonstration of an optically distributed clocking network for high speed digital switches and supercomputer applications, and the first observation of the optical nonlinearity induced by the cooling of highly excited electron-hole pairs in semiconductor optical amplifiers. While at Bellcore, Dr. Delfyett received numerous awards for his technical achievements in these areas, including the Bellcore Synergy Award and the Bellcore Award of Appreciation. Dr. Delfyett joined the faculty at the College of Optics & Photonics and the Center for Research and Education in Optics and Lasers (CREOL) at the University of Central Florida in 1993, and currently holds the positions of University of Central Florida Trustee Chair

Professor of Optics, ECE & Physics. Dr. Delfyett served as the Editor-in-Chief of the IEEE Journal of Selected Topics in Quantum Electronics (2001-2006), and served on the Board of Directors of the Optical Society of America. He served as an Associate Editor of IEEE Photonics Technology Letters, was Executive Editor of IEEE LEOS Newsletter (1995-2000) and sits on the Presidential Science Advisory Council of the Orlando Science Center. He is a Fellow of the Optical Society of America, Fellow of IEEE/LEOS, was a member of the Board of Governors of IEEE-LEOS (2000-2002), and is also a member of Tau Beta Pi, Eta Kappa Nu, and Sigma Xi, and SPIE. Dr. Delfyett has been awarded the 1992 YMCA New Jersey Black Achievement Award, the 1993 National Black Engineer of the Year Award – Most Promising Engineer, the University Distinguished Research Award '99, and highlighted in Design News' "Engineering Achievement Awards". In addition, Dr. Delfyett has been awarded the National Science Foundation's Presidential Faculty Fellow Early Career Award for Scientists and Engineers, which is awarded to the Nation's top 20 young scientists. Dr. Delfyett has published over 500 articles in refereed journals and conference proceedings, has been awarded 30 United States Patents, and has been highlighted on 'C-SPAN', "mainstreekweek.com" and in "Career Encounters", a PBS Special on technical careers in the optics and photonics field. Dr. Delfyett was awarded the 1999 University Distinguished Researcher of the Year Award, the 2000 Black Engineer of the Year Award – Outstanding Alumnus Achievement, and the 2000 Excellence in Graduate Teaching Award. He was awarded the University of Central Florida's 2001 Pegasus Professor Award which is the highest honor awarded by the University. He is also a Founding Member in NSF's Scientists and Engineers in the School Program, which is a program to teach 8th graders about the benefits of science, engineering and technology in society. In 2003, Dr. Delfyett received the Technology Innovation Award from the Orlando Economic Development Commission. He was selected as one of the "50 Most Important Blacks in Research Science in 2004" and as a "Science Trailblazer in 2005 and 2006" by Career Communications Group and Science Spectrum Magazine. Dr. Delfyett has also endeavored to transfer technology to the private sector, and helped to found "Raydiance, Inc." which is a spin-off company developing high power, ultrafast laser systems, based on Dr. Delfyett's research, for applications in medicine, defense, material processing, biotech and other key technological markets. Dr. Delfyett was also elected to serve 2 terms as President of the National Society of Black Physicists (2008-2012). Most recently, he was awarded the APS Edward Bouchet Award for his significant scientific contributions in the area of ultrafast optical device physics and semiconductor diode based ultrafast lasers, and for his exemplary and continuing efforts in the career development of underrepresented minorities in science and engineering. Awards & Honors International Society for Optics and Photonics (SPIE) Fellow American Physical Society (APS) Fellow IEEE Photonics Society Fellow Optical Society of America (OSA) Fellow 2019 Excellence in Graduate Teaching College Award 2014 Florida Academy of Science's 2014 Medalist 2013 National Academy of Inventors Fellow 2013 Letter of Appreciation – SPIE 2013 Faculty Excellence for Mentoring Doctoral Students 2013 College Research Incentive Award (RIA) 2012 Faculty Excellence in Mentoring Doctoral Students 2012 College Excellence in Graduate Teaching Award 2012 Excellence in Graduate Teaching Award 2011 Excellence in Graduate Teaching Award 2011 APS Edward Bouchet Award 2010 American Physical Society Edward Bouchet Award 2010 IEEE Photonic Society Graduate Student Fellowship 2010 SPIE Educational Scholarship in Optical Science and Engineering 2010 Incubic/Milton Chang Travel Award to attend CLEO 2006 Science Spectrum Trailblazer 2005 District Advocate for the American Physical Society 2005 Science Spectrum Outstanding Black Professional in Science 2003 Technology Innovation Award 2003 UCF Millionaire's Club 2002 Pegasus Professor Award 2002 UCF Distinguished Research Professor Award 2002 UCF Millionaire's Club 2001 UCF Nguzo Saba Award 2000 Research Incentive Award (RIA) Research Group Conducting research on ultrafast high power optical pulses from semiconductor diode lasers, for applications in applied photonic networks and laser induced materials modification.

Advanced optical fiber systems: What do we really need from the fiber?

Peter Dragic
University of Illinois at Urbana-Champaign, United States

Undeniably, optical fibers have played a key role in enabling a massive acceleration in the technological advancement of humankind. They have granted unprecedented wide-scale access to information, given rise to high efficiency and brightness amplifiers and lasers, and even serve as sensing modalities sometimes possessing astronomical dynamic range. Yet, the demand for greater performance continues driving novel fabrication methods, exotic waveguide design (today made easier by the availability of commercial software packages), and novel materials, each seeking to enhance some capability. At their convergence, we will consider the system level question "what do we really need from optical fiber?"

Biography

Peter D. Dragic received his Ph.D. from the University of Illinois at Urbana-Champaign, Urbana, IL, USA. He is currently an Assistant Professor in the same Department. His thesis work focused on the development of high-power fiber lasers for LIDAR instrumentation, and he has continued working on next-generation laser sources for sensing and high-power applications. He is keenly interested in the mitigation of fiber nonlinearities that limit scalability in them. He has more than 175 archival journal and conference papers, is a holder of 15 U.S. patents, and co-founded several start-up companies that focused on various optical technologies.

Fano Resonances in the Resonance Raman Spectra of Tubulin and Microtubules Reveals Active Quantum Effects

Microtubules are self-assembling biological nanotubes made of the protein tubulin that are essential for cell motility, cell architecture, cell division and intracellular trafficking. The unique mechanical properties of microtubules give rise to a high resilience and stiffness due to their quasi-crystalline helical structure. It has been theorized that this hollow molecular nanostructure may function like a quantum wire where optical transitions can take place, where photo-induced changes in microtubule architecture may be mediated via changes in disulfide or peptide bonds or stimulated by photoexcitation of tryptophan, tyrosine or phenylalanine groups, resulting in subtle protein structural changes owing to alterations in aromatic flexibility. Here we present the Raman scattering spectra of microtubules and its constituent protein tubulin in both dry powdered form and in aqueous solution and determine if molecular bond vibrations show active Fano resonances which are indicative of quantum coupling between discrete phonon vibrational states and continuous excitonic many-body spectra.

Biography

Travis J.A. Craddock, Ph.D. (Physics) is an Associate Professor in the Departments of Psychology & Neuroscience, Computer Science and Immunology at Nova Southeastern University (NSU) in Fort Lauderdale, Florida. He is the Director of the Clinical Systems Biology group at NSU's Institute for Neuro-Immune Medicine where he applies computational biophysics methods towards the purpose of identifying novel diagnostics and treatments for illnesses involving neuroinflammation. Dr. Craddock received his Ph.D. in biophysics at the University of Alberta where his graduate research activities focused on biomolecular information processing, and nanoscale descriptions of memory, and cognitive dysfunction in neurodegenerative disorders. His current research activities are focused on using a theory driven approach to understand the underlying molecular regulation of chronic illness resulting from exposure to neurotoxins, such as anesthesia and nerve agents, in order to improve diagnosis and treatment strategies. This work is primarily funded by the U.S. Department of Defense.

Travis J.A. Craddock[1,2,*], Robert R. Alfano[3,4] and Lingyan Shi[5]

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SESSION SPEAKER

Josef Vojtech
CESNET, Czech Republic
Research prize, Czech minister of education

Transmission of Precise Time and Ultrastable Optical Frequency within Telecommunication Networks

Presentation provides overview of fibre based infrastructure for Precise Time and Ultrastable Optical Frequency dissemination under development, overspreading from Czech Republic to Vienna and borders with Poland. Attention will be also given to other initiatives on European level and project Clock Network Services-Design Study (CLONETS-DS) aiming to establish a pan-European time and frequency reference system as a European Research Infrastructure. to serve the European science community.

Biography

Josef Vojtech received with honours MSc in Computer Science and PhD degree in the field of all-optical networking from the Czech Technical University, Prague, in 2001 and 2009, respectively. He leads research department of Optical networks CESNET a.l.e., e-infrastructure provider in the Czech Republic since 2015. He holds 13 patents (including 5 US) and multiple utility models. His record shows 140+ scientific publications. He participated in international projects: CLONETS-DS, TiFOON, CLONETS, COMPLETE, FI-PPP XIFI, GN4, GN3+, GN3, GN2, Porta Optica Study, SEEFIRE. He led contractual research for delivery of ultrastable coherent optical frequency for sensing of nuclear power plant containment stability and interconnection of quantum sources of ultra-stable optical frequency. He co-organizes Customer Empowered Fibre networks workshop since 2004 and special section on Photonic networks and their services within conference on Telecommunications and signal processing since 2016. He is a senior member of IEEE, OSA, SPIE and member of ION. In 2007 he received the research prize of the Czech minister of education. In 2007 he with Miroslav Karásek and Jan Radil received the research prize of the Czech minister of education.

SESSION SPEAKER

Recent Progress and Possible Trends in Infrared Technologies

Johannes Kunsch
Laser Components Gmbh, Germany

SESSION SPEAKER

The 1st and 2nd Global Talks on infrared topics were held on December 1-2, 2020, and January 19-20, 2021, as live online event. There were two sessions per day at one hour each with a total of 49 speakers and chairs from 14 countries. No sessions ran in parallel. More than 800 attendees from 35 countries followed the live event which can be streamed as well. The event brought together researchers, industry and end users and tries to approach infrared technology as a whole. Therefore, a rough estimate on progress and possible trends becomes possible by using our database of six previous IR WORKshops for comparison.

The QC laser-based non-invasive glucose monitor was a major contribution to the program. Spectroscopic basics, the schedule for ramping up to a smartphone-size device as well as competitive end-user pricing were presented. [3,4] Also, the following question to the community was raised: A small blood count based on FTIR is possible and the knowledge has been there for a while. So, why is there no instrument available?

The development of the Cr:ZnS fs laser is a major step towards the generation of mid-infrared ultrashort pulses with high power and low noise. This laser yields infrared power comparable to a synchrotron, but with extremely low noise. [5] At the end, broadband measurements over up to 10 decades become possible in combination with phase-resolved spectroscopy. [6] The advantages of phase-resolved spectroscopy, like stable base line, have been emphasized in another paper as well. Here, an external cavity QC laser was used as tunable light source. [7] It has been discussed in earlier events already, that the mid infrared suffers from bad knowledge of material parameters like the complex part of the refractive index preventing precise simulation. Those new technologies should be a great help in closing this gap.

A technological breakthrough was presented with a 768x512 pixels near infrared camera with 5 µm pitch. This camera targets to bring the price down since it is designed for a wafer-level process. [8] It uses a thin-film photodetector with PbS quantum dots that peak at 1.45 µm. Speaking on lead salt detectors, new light was shed on the basic function of polycrystalline PbSe photodetectors that have been out in the world for decades and still do outperform modern bandgap-engineered detectors in certain aspects. Modern investigations suggest a mostly uniform current across grains and connecting tissues and a PbI2/PbSe isotype heterojunction based on hole transport. [9]

Miniaturization by MEMS has been an infrared trend for a long time already. Here are 4 recent examples: At first, an MOEMS-based external cavity QC for real-time spectroscopy was presented [10]. Secondly, an on-chip polymer waveguide with 10 x 25 mm size was presented in order to replace bulky multipass cells. [11] Thirdly, the first palm-sized mid infrared FTIR platform was presented at the end of a tutorial on FTIR basics. [12] Last but not least, the specimen to be investigated and the infrared detector have been married into nanostrings and nanotrampolines covered with micelles. The readout signal is a detuning. A universal infrared thermal detector that targets photon-noise limits has been reported as well. Here, the micelles were replaced by gold nanoparticles. [13]

There is significant progress and activity on dielectric infrared optical components and materials. Five optical suppliers presented, which is a new record. Finally, the CO2 laser, which is still the most widely used infrared laser, does have its notch filter! [14,15] This has been standard in the visible and near infrared for a long time.

Papers that simplify existing instruments or make them more rugged and/or cheaper have always been promoted by our events: A common-path interferometer was introduced to make FTIR mechanically more robust. [16] Furthermore, compressive single-pixel imaging in the NIR that uses a fixed spatial modulator was successfully demonstrated. Image reconstruction is based on mathematics that uses a number of subsequent events. In some aspect this means, that the information is hidden in the noise. Additional insertion of a tunable filter does result in hyperspectral imaging. [17]

References:

[1] 1st Global Infrared Sessions, December 1-2, 2020, https://bit.ly/irsessions1

[2] 2nd Global Infrared Sessions, January 19-20, 2021, https://bit.ly/irsessions2

[3] Basics of Infrared Spectroscopy: Applications for the Analysis of Body Fluids and Advantages over Proxy Methods, Werner Mäntele, see [1]

[4] Say “Goodbye” to test strips: Non-invasive blood sugar monitor, Thorsten Lubinski, see [1]

[5] Multi-octave-spanning simultaneous infrared coverage driven by emerging Cr:ZnS laser systems, Kafai Mak, Nathalie Nagl, Qing Wang, Markus Poetzlberger, Philipp Steinleitner, Aleksandar Sebesta, Shizhen Qu, Vladimir Pervak, and Ferenc Krausz, see [1]

[6] Field-resolved Mid-infrared Spectroscopy, Marinus Huber*, Michael Trubetskov, Wolfgang Schweinberger, Syed A. Hussain, Christina Hofer, Mihaela Zigman, Ioachim Pupeza and Ferenc Krausz, see [1]

[7] Laser Based Mid-IR Dispersion Spectroscopy of Liquid Samples, Bernhard Lendl, see [1]

[8] Progress Towards PbS Quantum Dot Based Hi-res / Low-cost SWIR Imagers, Pawel E. Malinowski, Epimitheas Georgitzikis, Vladimir Pejovic, Luis Moreno Hagelsieb, Griet Uytterhoeven, Jiwon Lee, Yunlong Li, Steven Thijs, Tom Verschooten, Myung Jin Lim, Itai Lieberman, David Cheyns, see [1]

[9] Understanding Behavior of Lead Salt Photoconductors, Davorin Babic, see [2]

[10] MOEMS-based External Cavity QCLs and their application in real-time spectroscopy, M. Haertelt, S. Hugger, Y. V. Flores, C. Schilling, S. Adler, P. Holl, A. Merten, M. Schwarzenberg, A. Dreyhaupt, see [2]

[11] Latest results on gas sensing with on-chip waveguides, Marek Vlk, Aurup Datta, Jana Jágerská, Ganapathy S. Murugan, see [2]

[12] Sensor-Scale FTIR Spectrometers, Yasser Sabry, see [1]

[13] Nanoelectromechanical Photothermal Infrared Spectroscopy, N. Luhmann, R. Pliessnig, M. Piller, M.-H. Chien, J. P. Lafleur and S. Schmid, see [2]

[14] Infrared filters, Jason Palidwar, see [2]

[15] Advancements in IR Coating Technology, Patrick M. Carney and Patrick M. Brown, see [1]

[16] Fourier-Transform Spectroscopy, Microscopy and Hyperspectral Imaging using an Ultra-Stable Interferometer, Fabrizio Preda, see [1]

[17] NIR hyperspectral single pixel imaging, Paul Gattinger, see [1] or: Gattinger et al., "Broadband near-infrared hyperspectral single pixel imaging for chemical characterization," Opt. Express, vol. 27, no. 9, p. 12666, Apr. 2019. (Note: This presentation is missing on the recording because of a malfunction. Therefore, a second reference is given.)

Biography

Josef Vojtech received with honours MSc in Computer Science and PhD degree in the field of all-optical networking from the Czech Technical University, Prague, in 2001 and 2009, respectively. He leads research department of Optical networks CESNET a.l.e., e-infrastructure provider in the Czech Republic since 2015. He holds 13 patents (including 5 US) and multiple utility models. His record shows 140+ scientific publications. He participated in international projects: CLONETS-DS, TiFOON, CLONETS, COMPLETE, FI-PPP XIFI, GN4, GN3+, GN3, GN2, Porta Optica Study, SEEFIRE. He led contractual research for delivery of ultrastable coherent optical frequency for sensing of nuclear power plant containment stability and interconnection of quantum sources of ultra-stable optical frequency. He co-organizes Customer Empowered Fibre networks workshop since 2004 and special section on Photonic networks and their services within conference on Telecommunications and signal processing since 2016. He is a senior member of IEEE, OSA, SPIE and member of ION. In 2007 he received the research prize of the Czech minister of education. In 2007 he with Miroslav Karásek and Jan Radil received the research prize of the Czech minister of education. Josef Vojtech received with honours MSc in Computer Science and PhD degree in the field of all-optical networking from the Czech Technical University, Prague, in 2001 and 2009, respectively. He leads research department of Optical networks CESNET a.l.e., e-infrastructure provider in the Czech Republic since 2015. He holds 13 patents (including 5 US) and multiple utility models. His record shows 140+ scientific publications. He participated in international projects: CLONETS-DS, TiFOON, CLONETS, COMPLETE, FI-PPP XIFI, GN4, GN3+, GN3, GN2, Porta Optica Study, SEEFIRE. He led contractual research for delivery of ultrastable coherent optical frequency for sensing of nuclear power plant containment stability and interconnection of quantum sources of ultra-stable optical frequency. He co-organizes Customer Empowered Fibre networks workshop since 2004 and special section on Photonic networks and their services within conference on Telecommunications and signal processing since 2016. He is a senior member of IEEE, OSA, SPIE and member of ION. In 2007 he received the research prize of the Czech minister of education. In 2007 he with Miroslav Karásek and Jan Radil received the research prize of the Czech minister of education.

Igor Meglinski
College of Engineering & Physical Sciences, Aston University, Birmingham, UK

Spin Angular Momentum Of Light In Digital Histopathology

In the last decade, consistent and successful innovations have been achieved in the field of lasers and optics, collectively known as ‘photonics’, founding new practical applications from space (by NASA) to modern biology, medicine and consumer good devices, offering since recently the wearable gear (e.g. Apple Watch). While the global photonics market has reached nowadays □600 billion, only 20% of the potential power and benefits of light technologies have been unlocked so far. Light can be more complicated and structurally diverse, i.e. the light beams can be radially or azimuthally polarized, carrying so-called spin angular momentum (SAM) and orbital angular momentum (OAM), related to their spatial structure. While using the polarization of light in various biomedical applications has already known for years, the interaction of SAM/OAM light with cells has not yet been explored, and has been added to the potential practical toolkit only recently. We examine the use of fundamental properties of complex structured light with the ultimate aim to develop novel non-invasive optical diagnosis of cells and biological tissues with the highest possible sensitivity. With the systematic investigation of influence of cell structure malformation on the SAM and/or OAM of light and their changes due to multiple scattering we develop robust experimental systems/approaches suitable for routine clinical applications. In current presentation we introduce an automated stand-alone approach for segmentation of the abnormal regions in paraffin-embedded tissue block that are in good agreement with the ground truth provided by standard pathological analysis. The proposed approach provides a high potential to revolutionize routine procedures in frame of current practice of histological clinical tests.

Biography

Igor Meglinski is Professor in Biophotonics and Biomedical Engineering at Aston University (UK) and University of Oulu (Finland). His research interests lie at the interface between physics, biomedical engineering, medicine and life sciences, focusing on the development of new non-invasive imaging/diagnostic techniques. His recent main contributions include a number of pioneering studies/results on propagation and localization of light in biological tissues, use circularly polarized light and since recently vortices and twisted light for optical biopsy/histopathology, and the study of light scattering in non-ergodic tissue-like scattering medium. He published over 350 papers in peer-reviewed scientific journals (185), proceedings of conferences (161), book chapters (17) and 4 books, and delivered over 750 presentations at the major international conferences, symposia and workshops, including 30 keynotes and 187 invited lectures, and 88 invited lectures/seminars at the world leading research centres and the universities for students and young researchers. He is the Node Leader in Biophotonics4Life Worldwide Consortium (BP4L), Senior Member of IEEE, Chartered Physicist (CPhys), Chartered Engineer (CEng), Fellow of Institute of Physics and Fellow of SPIE.

Display optics Challenges for AR Smart Glasses. The monolithic plastic optics solution.

Khaled Sarayeddine
Inventor, New display systems, Disruptive Technologies
CTO & Co-Founder, Optinvent, France

All attempts to introduce consumer augmented reality (AR) smart glasses have failed so far because they have never managed to look like "normal glasses". None have gained significant traction with consumers because nobody wants to wear ugly, heavy and uncomfortable computing devices on their face. The problem is not industrial design. There are several technology breakthroughs required, but first and foremost is the see-through display which is at the heart of the smart glass product. Large FOV, high pixel per degree resolution, high power efficiency, excellent transparency, high visual comfort, and clearance are required while maintaining small size and weight for the display. Furthermore, the combiner in front of the wearer's eye cannot be made using a breakable glass substrate. This is a showstopper. Unbreakable plastic is the only long-term solution for consumers to confidently adopt this technology.

The presentation will give an overview of on the state of the art of display technologies for AR displays and will explain the solution developed by Optinvent based on its monolithic plastic light guide combiner that meets the above-mentioned requirements and offers a scalable, low-cost solution for the manufacturing.

Biography

Recognized expert in worldwide Display industry and leading figure in the field of Microdisplay based projection systems, compact projection systems, and near to eye optics. Chaired several industry consortium such as SID/IDW. Holds more than 20 patents in optics for projection and wearable displays. Inventor of new display systems and disruptive technologies with a vision on the consumer market. Proven experience as a Start-Up CTO driving innovation and multidisciplinary product development. Strong problem solving approach and ability to drive highly skilled development teams to reach challenging company goals. Hold Phd in Optics from the University of Franche Comté, Besançon, France and a "Diplome d'Ingenieur" from Ecole Supérieur d'Electronique et Electrotechnique; ESIEE, Paris in Semiconductor physics. Currently CTO and Co-Founder of Optinvent a French Start-up that offer the best technology for see-through video glasses for consumer market

SESSION SPEAKER

High-speed, High-accuracy Direct General Transfer Function Estimation Using a new Well-Optimized Linear Finder (WOLF) Method with Application to Diversity-based Atmospheric Turbulence Compensated Imaging Systems

William W. Arrasmith, PhD
Florida Institute of Technology, USA

A new high-speed, high-accuracy general transfer function estimation method is presented that has been found to be faster and more accurate than traditional methods used in transfer function estimation/blind-deconvolution problems such as removing atmospheric turbulence from coherent and incoherent optical imagery. Our new Well-Optimized Linear Finder (WOLF) method applies across the electromagnetic and acoustic spectrum and benefits any linear/linear shift-invariant (or linearizable) system where channel aberrations can be well-modeled as phase aberrations. A representative example of these type of aberrations are atmospheric aberrations found in imaging systems that are dominated by near-field atmospheric turbulence such as ground-to-air, or ground-to-space imaging systems. Our correlation-based method is implemented entirely in the spatial frequency domain and takes advantage of transfer function phase redundancies in the transfer function's complex exponential entrance pupil plane phase difference chains. In traditional methods, for imaging systems with a large number of pixels (or equivalently a large number of entrance pupil plane samples), up to millions of complex exponential phase differences need to be determined and summed at discrete points of the Optical Transfer Function (OTF). In our WOLF method, these millions of complex exponential phase difference sums have been reduced to a requirement of no more than the sum of 3 complex exponential phase difference terms at any point of the OTF. Additionally, unlike many traditional blind deconvolution methods that use iterative, weighted basis function expansion methods to estimate entrance pupil plane phase aberrations, our WOLF method is a single iteration method capable of exactly reproducing the entrance pupil plane phase given adequate entrance pupil plane sampling. Also, due to symmetries and the inherent phase redundancies in the OTF, only a subset of the OTF points need to be evaluated to fully determine the entrance pupil plane phase aberrations, further reducing the computational requirements of the WOLF method. As an example, we demonstrate the WOLF method on a simulated diversity-based imaging system using a statistically accurate realization of the Earth's atmosphere based on the Kolmogorov atmospheric model. We apply the atmospheric aberrations to a pair of 256 by 256 images (image and diversity image) and show that on a 2014 MacBook Pro computer with a 2.8 GHz Quad-Core Intel Core i7 processor with 16 GB of 1600 MHz DDR3 memory and running Matlab 2020b, the nonoptimized, non-parallel implementation of the WOLF method can reconstruct the turbulence free, diffraction-limited image in approximately 8 seconds. Our WOLF method is implementable using parallel processing technologies such as the Graphical Processing Unit (GPU) on a conventional laptop computer and/or Field Programmable Gated Array technologies with expected real-time (faster than 30 Hz) performance for software-dominant transfer function estimation/blind deconvolution/atmospheric turbulence compensation problems. The effects of additive Gaussian noise on the WOLF method are also presented.

KeyWords: General Transfer Function Estimation, Adaptive Optics, Atmospheric Turbulence Compensation, Blind Deconvolution Methods.

Biography

Dr. Arrasmith is currently a professor in the Department of Engineering Systems at FIT. He has 20 years experience with government research and development programs and has had extensive exposure to electro-optical, infrared, and laser detection systems. Prior to his position at Florida Tech, Dr. Arrasmith served as Program Manager of Physics and Electronics at the Air Force Office of Scientific Research (AFOSR) in Washington DC. In 1997 he moved to the United States Naval Academy in Annapolis, Maryland to teach courses in Engineering and Linear Adaptive Optics. Dr. Arrasmith was then reassigned to the Air Force Technical Applications Center (AFTAC) at Patrick Air Force Base where he became Chief of the Systems and Technology Division. He was later appointed Division Chief for the Advanced Science and Technology Division of the AFTAC and remained in the position until joining Florida Tech in 2003.

KEYNOTE SPEAKER

Wojciech Suder
Cranfield University, UK

SESSION SPEAKER

Challenges in high power laser processing

Lasers enable precise control of spatial and temporal energy, high precision, directionality, non-contact interaction with materials and delivery of well-defined wavelength. This makes them one of the most flexible tools widely used in various applications of material processing. However, most manufacturing processes use simple axisymmetric heat sources, and the processing parameters are often developed based on a parametric approach, without considering the material requirements and therefore not utilising the full potential of lasers. Most advanced materials require a careful control of applied energy, which can only be achieved with accurately controlled energy profiles tailored to a particular case. The energy profile and its delivery rate determine the interactions with the material, such as the heating rate, extent of melting or vaporisation, temperature gradient and driven by it melt flow, solidification rate and microstructural development. This, in turn, controls the final product, such as weld bead shape and mechanical properties in welding, cut roughness in cutting, quality of ablated surface in machining or smoothness and dimensions of deposited beads in additive manufacture. This work shows the importance of understanding laser material interaction and the role of optics in the control of delivered energy. Different high power laser processes were investigated with the emphasis on the material's response to the applied energy and its effect on the final product. The results show that to utilize all benefits of lasers and achieve highly controllable, robust and efficient laser processing, a new type of optical systems with tuneable temporal and spatial output, integrated real-time process monitoring and smart processing algorithms are needed. This opens new possibilities for smart laser processing.

Biography

Dr Wojciech Suder - a senior lecturer at Cranfield University working on various projects in laser processing and arc welding. In the last 10 years he has been working on understanding fundamentals and process development of high power laser processes, such as thick section welding, hybrid welding, additive manufacture and pulsed laser processing. He holds a PhD in laser welding from Cranfield University and an MSc in Materials Science from Gdansk University of Technology. He works actively towards promoting more robust "black art"-free laser welding, by encouraging better understanding of laser welding amongst the laser users. His work, therefore, has been strongly applied and closely collaborative with various industries.

Rajpal Sirohi
Padma Shri, FNAE, FNASc, FOSA, FSPIE, FOSI, AvH Awardee
Alabama A&M University, United States

KEYNOTE SPEAKER

Shearography and its Applications

A grainy pattern formed in space when a laser beam strikes an object is called a speckle pattern. It was considered a bane of holographers because the reconstructed images from the holograms were grainy. A number of methods were investigated to reduce this delirious effect. During the late sixties, it was discovered that the speckle pattern carries information about the object and hence could be used for measurement. Initially both speckle photography and speckle interferometry was investigated to measure displacement and deformation of the objects. It was realized that speckle interferometry could be configured to measure components of the deformation vector unlike the holographic interferometry. In the beginning, the recordings were made on photoemulsions (photographic plates or films) and the technique came to be known as speckle pattern interferometry. Since it was possible to control the size of the speckles in the pattern, electronic recording using vidicon tube was successfully attempted and the technique took a new name, that is, electronic speckle pattern interferometry (ESPI). When recording is done on a CCD or a CMOS and digital manipulations are carried out, the technique is known as digital speckle pattern interferometry (DSPI). Using ESPI/DSPI along with phase-shifting, the deformation map of the object subjected to an external agency is obtained almost in real-time. The technique is wholefield, extremely sensitive and can be configured to obtain either in-plane components or out-ofplane component or all the three components of the deformation vector simultaneously. It has also been applied to the study of vibrating object either in a time-average or a stroboscopic mode. Material scientists, stress analysts, quality assurance personnel, product developers and many others are interested not only in deformation but in strain values. Strain measurements are the basis for predicting how long an object will perform without failure when subjected to certain external influences. There are several techniques for strain measurement: some are point-wise, and some are whole-field techniques. Shearography is one of the optical techniques that has evolved both for qualitative and quantitative strain (difference quotient) measurements. When shear interferometry features are included in speckle pattern interferometry, it becomes speckle pattern shear interferometry (SPSI) or speckle shear interferometry (SSI) or simply shearography.

Shearography is a displacement gradient sensitive full-field optical technique that is resilient to the environmental disturbances and vibrations. It does not respond to rigid body translations. Being almost common-path technique, temporal coherence requirement is considerably relaxed. The experimental set-up is simple and offers reduced sensitivity to fill the gap between DSPI and moiré techniques. Initially various methods of shearing were investigated and shearography was used for visualization of slope and strain fringes. The recordings were mostly on photo-emulsions and slope and strain fringes were obtained by Fourier filtering. It was also used to visualize vibration modes. Later recording on CCD/CMOS along with phase shifting provided phase maps from which quantitative values of strain and slope could be obtained. Information. It has, however, found applications in non-destructive testing of components and structures used in aircraft and automobiles. It is finding applications for NDT of wooden and canvas paintings.

Biography

Prof. Rajpal Singh Sirohi did his Masters in Physics in 1964 from Agra University, and Post M.Sc. in Applied Optics and Ph. D. in Physics both from Indian Institute of Technology, New Delhi in 1965 and 1970 respectively. Prof. Sirohi was Assistant Professor in Mechanical Engineering Department at Indian Institute of Technology Madras during 1971-1979. He became Professor in the Physics Department of the same Institute in 1979. He joined IIT Delhi as Director in 2000 and superannuated in April 2005 from IIT Delhi.

During 2000 - 2011, he had been deeply engaged in academic administration and research as Director IIT Delhi (December 2000 - April 2005); Vice-Chancellor, Barkatullah University, Bhopal; (April 2005 - September 2007); Vice-Chancellor, Shobhit University, Meerut (October 2007 - March 2008); Vice-Chancellor of Amity University Rajasthan, Jaipur (March 2008 - October 2009) and Vice-Chancellor, Invertis University, Bareilly (January 2011 – October 2011). He was also the Visitor to the Teerthanker Mahaveer University, Moradabad (June 2012- June 2013). He is currently serving in the Physics Department, Alabama A&M University, Huntsville, Alabama USA. Prior to this (2013 - 2016), he was the Chair Professor, Physics Department, Tezpur University, Tezpur, Assam, India. He was Distinguished Scholar in the Department of Physics and Optical Engineering, Rose Hulman Institute of Technology, Terre Haute, Indian USA during 2011 - 2013.

Prof. Sirohi worked in Germany as a Humboldt Fellow at PTB, Braunschweig, and as a Humboldt Awardee at Oldenburg University. He was a Senior Research Associate at Case Western Reserve University, Cleveland, Ohio, and Associate Professor, and Distinguished Scholar at Rose Hulman Institute of Technology, Terre Haute, Indiana. He was ICTP (International Center for Theoretical Physics, Trieste Italy) Consultant to Institute for Advanced Studies, University of Malaya, Malaysia and ICTP Visiting Scientist to the University of Namibia. He was Visiting Professor at the National University of Singapore, and EPFL, Lausanne, Switzerland.

Prof. Sirohi is Fellow of several important academies/ societies in India and abroad including the Indian National Academy of Engineering; National Academy of Sciences, Optical Society of America; Optical Society of India; SPIE (The International Society for Optical Engineering), Instrument Society of India and honorary fellow of ISTE and Metrology Society of India. Recently, the Optical Society of India conferred on him the distinction of Distinguished Fellow. He is member of several other scientific societies and founding member of India Laser Association. Prof. Sirohi was also the Chair for SPIE-INDIA Chapter, which he established with co-operation from SPIE in 1995 at IIT Madras. He was invited as JSPS (Japan Society for the Promotion of Science) Fellow and JITA Fellow to Japan. He was a member of the Education Committee of SPIE.

Prof. Rajpal Singh Sirohi did his Masters in Physics in 1964 from Agra University, and Post M.Sc. in Applied Optics and Ph. D. in Physics both from Indian Institute of Technology, New Delhi in 1965 and 1970 respectively. Prof. Sirohi was Assistant Professor in Mechanical Engineering Department at Indian Institute of Technology Madras during 1971-1979. He became Professor in the Physics Department of the same Institute in 1979. He joined IIT Delhi as Director in 2000 and superannuated in April 2005 from IIT Delhi.

Prof. Sirohi has received the following awards from various organizations: Humboldt Research Award (1995) by the Alexander von Humboldt Foundation, Germany; Galileo Galilei Award of International Commission for Optics (1995); Amita De Memorial Award of the Optical Society of India (1998); 13th Khwarizmi International Award, IROST (Iranian Research Organisation for Science and Technology (2000); Albert Einstein Silver Medal, UNESCO (2000); Dr. YT Thathachari Prestigious Award for Science by Thathachari Foundation, Mysore (2001); Pt. Jawaharlal Nehru Award in Engineering & Technology for 2000, (awarded in 2002) by MP Council of Science and Technology; NRDC Technology Invention Award on May 11, 2003; Sir CV Raman Award: Physical Sciences for 2002 by UGC (University Grants Commission); Padma Shri, a national Civilian Award (2004); Sir CV Raman Birth Centenary Award (2005) by Indian Science Congress Association, Kolkata; Holo-Knight (2005), inducted into Order of Holo- Knights during the International Conference-Fringe 05-held at Stuttgart, Germany; Centenarian Seva Ratna Award (2004) by The Centenarian Trust, Chennai; Instrument Society of India Award (2007); Gabor Award (2009) by SPIE (The International Society for Optical Engineering) USA; UGC National Hari OM Ashram Trust Award - Homi J. Bhabha Award for Applied Sciences (2005) by UGC; Title 'Freedom of the Institute' conferred by Indian Institute of Technology Delhi in 2011; Distinguished Alumni Award (2013) by Indian Institute of Technology Delhi; Vikram Award 2014 by SPIE (The International Society for Optical Engineering) USA. According to Stanford University ranking report, he is listed with in 2% of the global scientists in Optoelectronics and Photonics.

Prof. Sirohi was the President of the Optical Society of India during 1994-1996. He was also the President of Instrument Society of India for three terms (2003-06, 2007-09, 2010-12). He was on the International Advisory Board of the Journal of Modern Optics, UK and on the editorial Boards of the Journal of Optics (India), Optik, Indian Journal of Pure and Applied Physics. He was Guest Editor to the Journals "Optics and Lasers in Engineering" and "Optical Engineering". He was Associate Editor of the International Journal "Optical Engineering", USA during (1999-Aug.2013), and currently is its Senior Editor (since August 2013). He is the Series Editor of the Series on 'Advances in Optics, Photonics and Optoelectronics' published by Institute of Physics (IoP) Publishing, UK.

Prof. Sirohi has 496 papers to his credit with 250 published in national and international journals, 78 papers in Proceedings of the conferences and 168 presented in conferences. He has authored/co-authored/edited thirteen books including five milestones for SPIE. He was Principal Coordinator for 26 projects sponsored by Government Funding Agencies and Industries, has supervised 25 Ph.D. theses, 7 M.S. theses and numerous B.Tech., M.Sc. and M.Tech. theses.

Prof. Sirohi's research areas are Optical Metrology, Optical Instrumentation, Laser Instrumentation, Holography and Speckle Phenomenon.

Enhanced Optical Fibers for Next Generation Distributed Sensing

Paul Westbrook
OFS Labs, United States
Session Chair

KEYNOTE SPEAKER

Distributed sensing applications typically rely on Rayleigh back scattering in standard optical fibers. We show that such scattering can be greatly increased in a new generation of senso fibers. Signal to noise improvements in excess of 10dB are possible in sensor fibers with both single and multiple cores. Enhanced scattering fibers offer enabling performance improvements for applications ranging from seismic sensing of oil wells, security systems and earthquakes, to medical shape sensing and structural health monitoring in future smart cities.

Biography

Paul Westbrook has degrees in Physics from the University of Michigan (B.S.) and MIT (PhD). In 1998, he joined the optical fiber research department at Bell Laboratories in Murray Hill, NJ. He is currently a technical manager at OFS Labs which was formed after the sale of the Lucent optical fiber business to Furukawa in 2001. He has worked on several optical technologies, including fiber sensors, polarization measurement, fiber lasers, optical fiber gratings, and photonic crystal fibers. He is a coauthor or coinventor on over 100 publications, conference proceedings, and patents. He has served as a committee member or chair for several conferences, including OFC, CLEO, IPC, BGPP, and CLEO Europe. He is currently an associate editor at APL Photonics, and was an associate editor at Fiber and Integrated Optics and IEEE PTL in the past. In 2017 he was elected a Fellow of the OSA.

Oomman K. Varghese
University of Houston, United States

KEYNOTE SPEAKER

Exceptional Properties of Hierarchical Oxide Nanostructures for Energy and Medicine

Among the areas requiring rapid transformations to meet the demands of future world, energy and medicine are in the forefront. While the problems associated with the present energy system and delays in developing alternative routes are major concerns in the energy sector, emergence of new lethal diseases and increasing health care costs bring unprecedented challenges to the medical community. Both these areas need the development of revolutionary materials, semiconductors in particular, to address the current and emerging issues. Low dimensional hierarchical structures have the potentials to solve outstanding challenges in energy production/conversion and medical diagnosis and treatment; however, cost and scalability issues hamper the commercialization prospects of many such materials and technologies. Anodic oxidation is a low cost scalable technique to grow hierarchical nanostructures of metal oxides. This more than a century old technique gained significant attention in the recent years due to the exceptional properties of the ordered low dimensional structures yielded by it. In this presentation, the unique properties of semiconducting metal oxides grown by this technique will be reviewed in the context of their applications in renewable energy conversion and diagnosis and treatment of diseases

Biography

Oomman K. Varghese received Ph.D. from Indian Institute of Technology Delhi (IITD), India. He conducted postdoctoral research in the University of Kentucky and the Pennsylvania State University and then worked as a Process Development Engineer in First Solar, USA. He is currently an Associate Professor in the Department of Physics, University of Houston (UH), Texas. His group's research is primarily aimed at developing nanoscale materials and heterostructures and investigating their unique properties for solar energy conversion and medical applications. He has contributed to over 100 peer reviewed articles, one book, two book chapters and three patents. His publications have received over 36,000 citations (Google Scholar h-index - 74). In 2011, Thomson Reuters ranked him 9th among 'World's Top 100 Materials Scientists' in the past decade. In 2014, 2015 and 2016 he received the title 'Highly Cited Researcher' and had his name listed in Thomson Reuters' World's Most Influential Scientific Minds. He is a recipient of the UH College of Natural Science and Mathematics John C. Butler Award for Excellence in Teaching. He is among the top 2% of the scientists in the world per the Stanford University Report, 2020."

Bridging the gap between optics and life science using Photoacoustic and nonlinear optical microscopy

Yang Pu, Ph.D.
Chief Technology Officer (CTO) of Davinci Applied Technologies Inc., United States

SESSION SPEAKER

Although near-IR light can reach several centimeters into tissue, it will likely have undergone hundreds of scattering events. A scrambled photon path inhibits effective optical focusing. Fortunately, ultrasonic waves induced by photons in tissue are scattered much less. By combination of optical excitation with ultrasonic detection, Photoacoustic imaging (PAI) technique, a hybrid imaging modality, acoustically detects optical absorption contrast via the photoacoustic (PA) effect. PAI has a deep penetration depth that is comparable with ultrasound imaging and can monitor multiple independent optical reporters simultaneously in vivo based upon wavelength. PAI is sensitive to optical absorption contrasts by pumping the characteristic peaks of the key molecules in biological tissue and is able to penetrate deep tissue comparable with ultrasound. Combining with nanosecond (ns) pulse laser excitation at different wavelengths, this technique can monitor multiple independent optical reporters simultaneously in vivo based upon characteristic wavelength of molecules of our interest. These advantages make PAI unmatched in comparison with any other in vivo optical-based imaging techniques. Photoacoustic technology is available to help advance life science research in neuroscience, cell biology, and in vivo imaging. In this presentation, we will review PAI techniques, from PA effect to photoacoustic microscopy (PAM), the development of optical-resolution photoacoustic microscopy (OR-PAM), functional brain imaging, and therapeutic efficiency of anticancer drug monitoring glioma treatment in small animal models. Solid-state nanosecond (ns) lasers are the optimal excitation source widely used in PAI to induce PA effect. This type of laser outperforms other types of lasers in PA applications. Therefore, the concept and design of solid-state lasers will be illustrated to emphasize their application in PAI technique. The results demonstrated that high spatial resolution OR-PAM systems with ns pulse lasers at selective wavelengths are promising approaches for future brain imaging, label-free tumor imaging, drug therapeutic effect and delivery monitoring, and other important biological and biomedical applications. For the future outlook, we will address two bottlenecks that impede the wide-spread implementation of PAI: 1) high energy laser; and 2) corresponding multichannel data acquisition (DAQ) electronics, which cause unaffordable high cost for the PAI system. Combination of ORPAM and nonlinear optical microscopy technologies is another promising direction since it allows pathologists to gain the molecular information as well as enough information for traditional pathology which they were trained since their career. If success, it will cause the revolutionary advancement of the regulations of current pathology in cancer detection and cancer grading system.

Biography

Dr. Yang Pu is current a CTO of Davinci Applied Technologies (DAT) Inc., NY 11790, USA. The missions of DAT to develop and manufacture industry and scientific laser, as well new laserbased imaging technologies and products. Dr. Pu obtained his Ph.D. degree in Electrical Engineering at the City College of City University of New York (CCNY of CUNY). He is a skilled multi-disciplinary experienced biomedical optics researcher. He has published 39 journal papers, 1 book, 6 book chapters, over 60 conference papers, and delivered over 60 presentations in conferences. His research is trying to breakthrough two limits of optics: 1. Enhancing the resolution of microscope to break the limitation of diffraction; and 2. Imaging deep organ of large animal and human using Photoacoustic technology. He was a Principal Investigator (PI) of Prostate Cancer Research Program (PCRP) from U. S. Army Medical Research and Material Command (USAMRMC). His research is currently focused on photoacoustic tomography and spectral near infrared (NIR) imaging using native contrast or contrast agent for early cancer detection using cancer targeting contrast agents (mainly on prostate and breast cancer), ultrafast time-resolved spectroscopy in biological environment, inverse model for 3D imaging location, and super-resolution microscopy of cancer cell. In application, his is trying to break through the bottlenecks of photoacoustic tomography screening for clinical use – high performance and low-cost multiple channels DAQ device and high energy laser system.

A novel nanocomposite based on 2D nanosheets, Ti3C2 MXene and 1D nanowires, KxWO for application in diabetes care

Danling wang
North Dakota State University,
United States

Acetone existing in human breath is an effective biomarker of diabetes, which can be used for the early diagnosis and daily monitoring of diabetes. Comparing to the conventional method for diabetes diagnosis and monitoring that analyzes the blood glucose level in blood, detection of breath acetone is a very need of a method in view of its merits such as non-invasive, accurate, convenient, and inexpensive. Recently, our group has reported a new breath acetone sensor based on a novel nanostructured x7O22 (xO) which exhibits a very sensitive response to acetone at the room temperature. The lowest concentration of acetone can be detected down to 1.2 ppm with response time of 12 s. However, considering the screening purpose of diabetes, concentration of acetone 0.76 ppm is the key threshold to distinguish health person and highrisk of diabetes person. In order to increase the sensitivity of acetone detection furtherly, a new nanocomposite made by 2-D Mene, Ti3C2 nanosheets and 1D xO has been recently synthesized in our group. The initial sensing testing shows excellent acetone response, which can be down to 0.2 ppm. On the other hand, due to good electric conductivity of Ti3C2 nanosheets, the acetone sensor based on Ti3C2-xO has stable electric property and exhibits excellent selectivity as well. This study can improve the understanding of the new material and its acetone sensing mechanism, and thus give ideas for further increasing the sensitivity for acetone detection, eventually resulting in an advanced material capable to analyze acetone in the exhaled breath for disease diagnosis and monitoring purpose.

Biography

Danling Wang is an Assistant Professor of the Department of Electrical and Computer Engineering at North Dakota State University, where she has been since 2016. Dr. ang graduated from Department of Electrical Engineering in University of ashington, Seattle, in 201. Since 200, her research is focused on investigation of portable chemiresistive sensors particularly based on nanostructured materials such as metal-oxide semiconductors in application to explosive detector in industry and military, and breath analyzer for early stage disease diagnosis. The theme of her research is to create high performance sensor devices through exploring the relationships between the compositionstructure of materials and their electric, optical and electrochemical properties and studying the interaction between gas molecules and a solid-state film. The main goal of her research is to deliver in-depth fundamental research with regard to sensor materials and devices in application of disease diagnosis, health status monitoring, industrial and food safety.

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Binlin Wu
Southern Connecticut State University, United States

SESSION SPEAKER

Intraoperative margin detection and grading of human meningioma using a handheld visible resonance Raman analyzer and machine learning

Meningiomas are the most common brain neoplasms that account for about 36.6% of all central nervous system (CNS) tumors. The extent of resection and the tumor grade are the two most important factors that affect the recurrence rate. Total surgical resection is the most effective solution for symptomatic meningiomas. Tumor margin identification is critical in a neurosurgery, however, often times challenging for neurosurgeons. New techniques for accurate and rapid intraoperative identification of negative margins from different grades of tumors are desired. Here we report for the first time the preliminary results to evaluate an optical analyzer (VRR-LRRTM Model# LRR2000) based on visible resonance Raman (VRR) technique with 532nm excitation for identifying meningioma margins and grades intraoperatively. The observations of the preliminary analysis include the following. The intensity ratio of VRR peaks of protein to fatty acid (2934/2888cm-1) decreased with the increase of meningioma grade. The ratio of VRR peaks of phosphorylated protein to amid I (1588/1639cm-1) decreased for the higher grade of meningioma. Three RR vibration modes at 1378cm-1, 3174 cm-1, and 3224cm-1 which were related to the molecular vibrational bands of oxy-hemeprotein, amide B and amide A protein significantly changed in peak intensities in meningioma tissues compared to the normal tissue. The changes in the intensities of VRR modes of carotenoids at 1156cm-1 and 1524cm-1 were also found in the meningioma boundary and disappeared in the tumors. These Raman peak changes may be used as the markers for intraoperative meningioma margin detection and grading. The accuracy for distinguishing meningioma margins and different grades using support vector machines (SVMs) was about 70% based on Raman peaks of key biomolecules and principal component analysis (PCA).

Davorin Babi□
Laser Components DG, Inc., United States

SESSION SPEAKER

Lead Selenide Transport and Conductivity Mechanism

Lead selenide (PbSe) photoconductors are very popular type of lead salt photodetectors in the infrared spectrum because of their excellent room temperature operation, outstanding price to performance ratio and large detector area manufacturability. Main application areas of the PbSe photodetectors are medical and environmental gas analysis, process control, flame and fire detection and optical pyrometry. However, their photoconductive and carrier transport mechanism has not been well understood so far. Laser Components DG, Inc. (LCDG) is a leading vendor of the PbSe photodetectors and fabricates PbSe polycrystalline thin film detectors using chemical bath deposition (CBD) technique. After the deposition, the thin film PbSe detectors are sensitized by oxidation and iodization. The completed LCDG detectors have sheet resistance values of about 1 MΩ per square. In order to ascertain the photoconductive and transport mechanisms of the LCDG detectors they have been characterized by a number of material characterization and electro-optic techniques. The characterization results suggest that only p-type PbSe detectors are photosensitive and that their photoconductivity is based on majority hole carrier transport. The PbSe detector thin films consist of grains and connecting tissue. The grains are lead selenide while the connecting tissue is a combination of lead selenide and lead oxide, likely as PbSeO3. The I-V characteristics of the completed PbSe are very linear pointing to no barrier related hole transport that takes place in the connecting tissue. The oxidation of a deposited PbSe film is required for its photosensitivity but introduces substantial nonlinearity and dramatic changes in its hole mobility. The iodization restores linearity of the I-V characteristics and substantially increases photosensitivity of the PbSe photodetectors. The characterization results fully support the number modulation model while being inconsistent with the recently proposed charge separation junction model.

Acknowledgement: The author wishes to acknowledge his collaborators on this project: G.-P Chen, Y.-H. Zhang (both from Arizona State University) and L.W Johnson, J. J. San Roman and D. Grubiši□ (all from LCDG).

Keywords: Lead selenide photodetectors, photoconductive and transport mechanism

Biography

Davorin Babi□ received M Sc. and Ph.D. degrees from the University of Pennsylvania, Philadelphia, PA USA where he investigated and achieved deposition of amorphous GeSe2 from an organic solution of GeSe$_2$ crystalline powder and developed new insight into models of the structure of amorphous As2S3 and As2Se3 by calculating their electronic structure. In 1991 he became Research Assistant Professor at University of North Carolina at Charlotte studying optoelectronic properties of silicon quantum dots caused by electrostatic screening and modifications of dielectric function in the nanoscale and he co-developed a novel technique for measurement of barrier height distribution at Si/SiO2 interface. He joined the University of Illinois at Chicago in 1994 where he conducted research on Si surface passivation in Si doped TMAH solution, observed Si surface passivation in Si doped KOH solution and proposed a model for the passivation mechanism. In 2002 he joined Johnson Research and Development where he developed novel devices and systems for energy storage and conversion. He invented a highly conductive amorphous lithium ion conducting solid electrolyte prepared by sol gel technique. He also developed electrochemical cells that utilize thin film proton conducting ceramic electrolyte. He joined Laser Components DG, Inc. in 2014 where he currently directs research and development of novel photodetectors and improvements of already existing photodetectors with special focus on the infrared. He is a member of SPIE and has 50 publications including 14 patents and 6 pending patent applications.

International Scientific Conference on

LASERS, OPTICS, PHOTONICS AND SENSORS

Acousto-ultrasonic Applications of Fiber Optic Sensing

Indu Fiesler Saxena
INNOVEDA, United States

Multichannel capability with lightweight fiber optic sensors and electromagnetic interference-free signal transmission are well-known significant advantages of fiber optical sensing. In addition, the ability of amorphous fused silica based optical fibers to operate in adverse environments for extremely long durations gives them the competitive edge, such as in high radiation of nuclear power plants and high temperatures approaching 1000 C, under which semiconductor sensors cannot survive.

Key fiber optic sensing concepts as applied to acoustics and ultrasonic detection for structural monitoring and in diagnosing anomalous operation of dynamical systems will be reviewed in this webinar as well as contemporary instrumentation capabilities.

Their applications in underwater monitoring, materials characterization in the transportation sector as well as in the energy sector will be presented.

SESSION SPEAKER

Nooshafarin Kazemikhoo
St. George Hospital, University of New south wales, Australia

SESSION SPEAKER

Effect of photo biomodulation on the healing process of donor site in patients with grade 3 burn ulcer after skin graft surgery (a randomized clinical trial)

Skin graft is a standard therapeutic technique in patients with deep ulcers but managing donor site after grafting is very important. Although several modern dressings are available to enhance the comfort of donor site, using techniques that accelerate wound healing may enhance patient satisfaction. Low-level laser therapy (LLLT) has been used in several medical fields, including healing of diabetic, surgical, and pressure ulcers, but there is not any report of using this method for healing of donor site in burn patients. The protocols and informed consent were reviewed according to Medical Ethics Board of Shahid Beheshti University of Medical Sciences (IR.SBMU.REC.1394.363) and Iranian Registry of Clinical Trials (IRCT2016020226069N2). Eighteen donor sites in 11 patients with grade 3 burn ulcer were selected. Donor areas were divided into 2 parts, for laser irradiation and control randomly. Laser area was irradiated by a red, 655-nm laser light, 150 mW, 2 J/cm2, on days 0 (immediately after surgery), 3, 5, and 7. Dressing and other therapeutic care for both sites were the same. The patients and the person who analysed the results were blinded. The size of donor site reduced in both groups during the 7-day study period ($P < 0.01$) and this reduction was significantly greater in the laser group ($P = 0.01$). In the present study, for the first time, we evaluate the effects of LLLT on the healing process of donor site in burn patients. The results showed that local irradiation of red laser accelerates wound healing process significantly.

Biography

I am a MD, PhD, Post Doc in Medical Laser and I have been using photo biomodulation (PBM) and low-level laser therapy (LLLT) for wound healing particularly non healing diabetic wounds candidate for amputation and burn wounds which require split thick ness skin graft, since 2003. I have published 22 international papers and 2 books in this field. I have run several workshops and training courses on PBM in both academic and non-academic courses and have delivered several oral and poster presentations at international conferences.

Currently working as research fellow and laser specialist in St. George Hospital, University of New south wales, Sydney, Australia

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Nicolas Javahiraly
University of Strasbourg, France
Session Chair

Review on the progress of nano-sensors for hydrogen leaks – nanostructured sensors based on palladium nanoparticles

Hydrogen seems to be one of the alternative ecological sources of energy related to numerous industries. It is presented as the sustainable energy carrier of the future. Hydrogen may be used to produce, store and transport energy and its possible applications are wide ranging. The industry based on the use of gaseous hydrogen has to meet the safety standards connected to the physical and chemical properties of hydrogen and to its operating conditions (pressure and temperature range). Hydrogen is a flammable and highly explosive gas: the lower flammability point is 4% in air going up to an upper limit of 74.5% and the ignition energy in air is as low as 0.02 mJ. The present hydrogen detectors use electrical sensors that may be subject to short-circuits and produce sparks. In order to eliminate this risk, for example, optical sensors appear as a sensible alternative for hydrogen detection. They exhibit sensitivity and response time equivalent to electrical devices without involving hazardous conducting parts. Moreover, they are intrinsically insensitive to electromagnetic perturbations. This review is devoted to describing the recent progress in the innovative nano-sensors for hydrogen leak detection exploiting the properties of Palladium nanoparticles or nanostructured designs to bring a real breakthrough into detection performances.

Keywords: Hydrogen, sensors, review.

Biography

Nicolas Javahiraly is an associate professor in physics at the University of Strasbourg. He did his PhD in Photonics at the same university on fiber optic sensors. After a post-doc at Harvard University on the interaction between ultra-short laser pulses and matter, he worked as a project manager and expert in the Sagem Defense group in Paris. He joined the University of Strasbourg in 2007 and is currently working on nano-optical sensors and plasmonics for various applications such as gas detection, pollutants detection and photoconversion systems for example.

KEYNOTE SPEAKER

Design of a high-performance photoconductive terahertz modulator enhanced by photonic crystal cavity

Faramarz Alihosseini, Zahra Heshmatpanah and Hesam Zandi*

Faculty of Electrical Engineering,
Electronic Materials Laboratory,
K. N. Toosi University of Technology,
Tehran, Iran

Terahertz (THz) science and technology have been adopted widely in the communication systems in recent years [1]. In this area, THz modulators have been emerged as one of the most functional devices and subjected to intensive study and development. In order to modulate THz wave efficiently, different research groups utilized various techniques and materials including metasurfaces [2], two dimensional materials [3], liquid crystals [4], nanoparticles [5] and photonic crystals [6]. Optical modulation is preferred to electrical ones because of its superior performance for the characterizations of broader bandwidth, faster speed and higher modulation depth [7]. However, for optically controlled modulators, achieving large modulation depth require considerable energy consumption. Hence, it is desirable to enhance the light matter interaction by trapping the THz wave inside a cavity. We propose and numerically investigate an optically-controlled terahertz (THz) modulator based on photocarrier generation in GaAs, incorporated with photonic crystal cavity-waveguide coupling structure which is shown in the figure below. Here, we demonstrate that the intensity of THz traveling-wave can be tuned by varying the conductivity of the GaAs through an infrared optical pumping. In this platform, the generated free electrons interact with the THz wave and reduce the transmission intensity through the semiconductor. This modulator benefits from strong interaction between THz wave and photoconductive material for achieving deep modulation with GHz modulation rate even with low pumping power. We analyze the device properties in time and frequency domains using the finite element method.

Conclusion It is demonstrated that increasing the conductivity of GaAs by the illumination of a laser, causes the intensity modulation of THz wave. We can adjust the structural parameters for particular operation frequencies exhibiting excellent performance with the ability to follow a high-speed modulating signal with low pump power intensities. Simulation results indicate that when the optical pump intensity was tuned from 2 W/cm2 to 55 W/cm2 this modulator can operate with a high modulation depth from 81.6% to 98.2% and also a high modulation rate up to 3 GHz for 1 THz carrier wave. These unique features of the modulator make it a good choice for development of future efficient and high-speed THz communication systems.

SPEAKER

International Scientific Conference on
LASERS, OPTICS, PHOTONICS AND SENSORS

Control field Rabi frequency managed broadband supercontinuum generation in a semiconductor quantum well nanostructure

Nitu Borgohain*, Rajnandan Lahkar, Abhijit Shyam, and Jyotismita Borah
Department of Physics, University of Science & Technology Meghalaya, India

This article presents a theoretical investigation on broadband supercontinuum generation in a semiconductor quantum well (SQW) nanostructure by using ultra-sort pulses under an electromagnetically induced transparency (EIT) scheme. The EIT window was created by employing a weak probe pulse along with a strong control field in the SQW in a ladder-type excitation scheme. The SQW exhibits very large nonlinearities and low dispersions within the EIT window, which subsequently employed to achieve broadband supercontinuum generation. The variation of control field Rabi frequency (Ωc) offers a very good adjustment over the magnitudes of nonlinearities and dispersions at a particular probe frequency. By tuning the value of Ωc, suitable sets of nonlinearity and dispersion can be selected, which can facilitate the enhanced broadening of the supercontinuum spectra at a much low input power level.

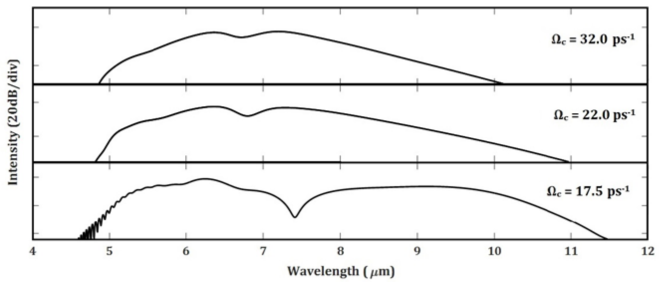

Fig. 1: Spectral profiles of sech-Gaussian pulses at the end of 1.38 μm long SQW nanostructure, for three different values of control Rabi frequencies Ωc = 32.0 ps-1 (top), Ωc = 22.0 ps-1 (middle), and Ωc = 17.5 ps-1 (bottom). Pulse peak power 400 W and FWHM pulse duration 50 fs.

Keywords: *Semiconductor Quantum well, Electromagnetically Induced Transparency, Rabi frequency, Nonlinearity, Dispersion, Supercontinuum Generation.*

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Biography

He is Assistant Professor in Department of Physics, University of Science & Technology Meghalaya (USTM), India. Ph.D. from Department of Physics, Birla Institute of Technology, Mesra, Ranchi, India (in 2019). Published 11 research papers in peer reviewed international journals, Published 18 research articles in conference proceedings, Google Scholar Citations: 122 Google Scholar h-index: 6. He supervised 10 post graduate student projects, Established an Astronomical Observatory in USTM

SPEAKER

Dispersive White Light Supercontiuum Single Z-scan: A new method to determine the two-photon absorption spectrum

Aliasghar Ajami
Faculty of Physics Semnan University, Iran

Two-photon absorption (2PA) has attracted many researchers due to its unique potential for those special applications which is not feasible based on linear absorption. Therefore, determining the 2PA coefficient/cross section is of most important.

Many different methods have already been proposed for determining the 2PA coefficient within which the Z-scan technique have been used extensively.[1] In traditional Z-scan method the 2PA coefficient is determined at a Sigle wavelength produced by the laser source employed in the setup. For most 2PA based applications, it is highly required to determine the 2PA spectrum to find out the peak 2PA absorption. To this end, different methods have been proposed:

1- Z-scan using a tunable laser: Applying this method yields to obtain the 2PA spectra via pointby-point which is cumbersome and time-consuming.[2] 2- Using a White light supercontiuum (WLC) source with a series of narrow band filters. This is also a point-by-point measurement which is cumbersome and time-consuming.[3] 3- Using nondispersive WLC Z-scan: in this method it is not feasible to determine the pure degenerate 2PA spectra since both degenerate and non-degenerate processes simultaneously occur.[4] 4- Using dispersive WLC without scan: In this method the obtained 2PA spectrum is although of degenerate nature, it represents the relative, but not the absolute value of the 2PA cross section.[5]

5- Our proposed technique: A unique method, by which the absolute visible-to-near-infrared degenerate 2PA spectra can be determined via performing a dispersive WLC single Z-scan. This technique can be used for a rapid determination of the wavelength-resolved 2PA spectra of any nonlinear medium ranging from semiconductors to organic solutions.[6, 7]

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SESSION SPEAKER

Nicolas Javahiraly
University of Strasbourg, France
Session Chair

KEYNOTE SPEAKER

Review on the progress of nano-sensors for hydrogen leaks – nanostructured sensors based on palladium nanoparticles

Hydrogen seems to be one of the alternative ecological sources of energy related to numerous industries. It is presented as the sustainable energy carrier of the future. Hydrogen may be used to produce, store and transport energy and its possible applications are wide ranging. The industry based on the use of gaseous hydrogen has to meet the safety standards connected to the physical and chemical properties of hydrogen and to its operating conditions (pressure and temperature range). Hydrogen is a flammable and highly explosive gas: the lower flammability point is 4% in air going up to an upper limit of 74.5% and the ignition energy in air is as low as 0.02 mJ. The present hydrogen detectors use electrical sensors that may be subject to short-circuits and produce sparks. In order to eliminate this risk, for example, optical sensors appear as a sensible alternative for hydrogen detection. They exhibit sensitivity and response time equivalent to electrical devices without involving hazardous conducting parts. Moreover, they are intrinsically insensitive to electromagnetic perturbations. This review is devoted to describing the recent progress in the innovative nano-sensors for hydrogen leak detection exploiting the properties of Palladium nanoparticles or nanostructured designs to bring a real breakthrough into detection performances.

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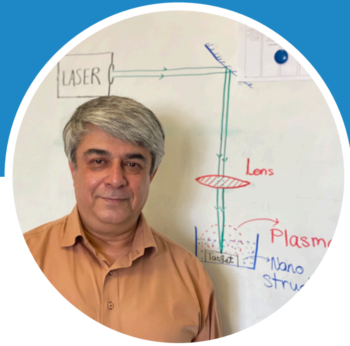


Review on lasers synthesis and processing of nanostructures

Davoud Dorranian, Elmira Solati,
Laser Lab., Plasma Physics Research Center, Science and Research Branch, Islamic Azad University, Iran

SPEAKER

Lasers are one of the effective tools to improve material processing. The laser beam cuts thick metals more finely than any cutter machine. The laser beam drills thick steels more accurately than any drill. Without lasers, welding technology was imperfect. Furthermore, printing, forming, and holograming are other roles of lasers in material processing. The present century began with the rapid development of nanotechnology, which opened new fields for laser applications in material science.

In this short review, I am going to present my works on laser synthesis and processing of nanostructures include nanoparticles (Au), nanocomposites (TiO_2), nanoalloys (Au/TiO_2), MOFs (MOF5; metal-organic framework compound with the formula $Zn_4O(BDC)_3$) and graphene. The physical mechanisms, responsible for production of different forms of nanostructures will be discussed in detail. The fundamental wavelength/second harmonic of Nd-YAG laser at 1064 nm/532 nm and 7 ns pulse width was employed to carry out the experiments via pulsed laser ablation process in liquid environment. The laser fluence, repetition rate, as well as the liquid environment are powerful tools by which the regime of laser ablation and the ablation products can be controlled.

Variety of diagnostics were employed to study the characteristics of nanostructures after their production. UV-Vis-NIR absorption and transmission spectroscopies were used to investigate the optical properties of nanostructures. Their molecular bonds and crystalline structure were studied using FTIR spectra and X-ray diffraction pattern respectively. And size and morphology of synthesized nanostructures were observed by TEM and SEM images.

Results confirm that pulsed laser ablation in liquids (PLAL) is a capable method to synthesize different forms of materials in nano dimension. PLAL is a friendly environment and easy method for material processing in atmospheric pressure. Composition, size, morphology, and other properties of nanomaterials can be easily controlled by PLAL parameters such as laser wavelength, laser pulse width, laser spot size, as well as liquid environment parameters.

Biography

Davoud Dorranian received the BS degree in applied physics from the Urmia University, Urmia, Iran in 1992 and MSc degree in atomic and molecular physics (plasma physics, MCF) from I. Azad University, Tehran, Iran in 1995. He graduated with a PhD in Utsunomiya University, Utsunomiya, Japan in 2003. His PhD research was an experimental work on the radiation phenomena in the interaction of high-power ultrashort pulsed laser with plasma. He then joined the Plasma Physics Research Center of I. Azad University in Tehran, Iran, where he is now full professor. Since 2005 he has been the editor-in-chief of the Journal of Theoretical and Applied Physics. His research activities have been concentrated on the study of nanosecond laser pulses and materials with the focus on the laser ablation produced nanostructures. Theoretically, he works on the interaction of high power lasers with plasma and waves in plasmas.

Using Deep Learning in Optical System and Lens Design

Simon Thibault
Université Laval Centre for Optics, Photonics & Laser, Canada
Chair, Member, Conference Committee
SPIE, OSA Conferences, Canada

SPEAKER

Over the last decade, AI becomes a more an more popular field particularly in vision to enable many new function like identifying image contents. So does deep learning network can be used to help or support optical system design. Design activities highly rely on designer experiences. So does a trained DNN on previous lens design or photonic devices can be used to infer design starting points. In this talk, we will explore to most recent applications of AI in optical and lens design. We will also show some working example and discuss the future.

Biography

Simon Thibault received a BSc in physics engineering in 1994 and a master's degree in physics in 1995 from Université Laval (Québec). He completed his PhD in 1998. The topic of his thesis was the optical design and testing of an optical 3D sensor using a liquid mirror. OSA Senior member (2015) and SPIE Fellow (2018), he is involved in various SPIE and OSA conferences as conference chair or member of conference committee.

Mid-infrared sources, based on chalcogenide glass fibers

Angela B Seddon[a]
[a]Mid-Infrared Photonics Group, George Green Institute for Electromagnetics' Research, Faculty of Engineering, University of Nottingham, NG7 2RD, UK

Mid-infrared (MIR) direct fiber lasers beyond 4 μm wavelength will deliver optimum beam quality of bright, spatially and temporally coherent light, routeable in MIR fiber-optics. They are being developed for applications including narrow-band biomolecular sensing, medical laser surgery at new, long wavelengths and for pulsed seeding of long-wavelength MIR- supercontinua in MIR glass fiber for all-fiber, compact systems for broad-band MIR medical sensing and hyperspectral imaging. Low phonon energy, selenide chalcogenide glasses are the optimum glass host for lanthanide ion doping for emission across the 3 to 10 μm wavelength MIR region. Here, we report our recent advances including: > 1 mW incoherent emission in the 4-5 μm wavelength region; demonstration of gain beyond 4 μm in Pr^{3+} doped chalcogenide glass fiber, and proposed quasi three-level lasing beyond 4 μm in Tb^{3+} doped chalcogenide glass fibers. Encouragingly, since 2020, lasing in both Pr^{3+} and Tb^{3+} selenide chalcogenide bulk glasses has been reported. Our overall goal is for new portable, MIR spectroscopic systems based on chalcogenide optical fibers for in vivo sensing, imaging and treatment in healthcare, including for early diagnosis of disease.

Keywords: Mid-infrared, fiber lasers, lanthanide ion doping, bulk glass lasers, chalcogenide glasses.

Biography

I lead the Mid-Infrared Photonics Group at the University of Nottingham, UK. My vision is to bring about a new paradigm in mid-infrared (MIR) biophotonics for portable, real-time, sensing and imaging in medicine based on new MIR fibreoptics, including for real-time, in vivo cancer diagnosis. I run a world-class suite of labs. dedicated to the synthesis and characterisation of long-wavelength mid-infrared optical fibres and devices. My seminal 1995 paper cited 591x rekindled interest in MIR chalcogenide-glass photonics. The Royal Academy of Engineering / Leverhulme Trust Senior Research Fellowship (2007 / 08) & Medical Research Council, Discipline Hopping Fellowship (2008 / 09) were awarded to initiate my MIR biophotonics' research. My Optics Express review re-set some ground rules for achieving MIR fibre lasingcited 274x. With DTU, Denmark, we set a world record (held for 6 months) in 2014 in broadband MIR sources demonstrating a MIR-supercontinuum spanning 1.4 μm to 13.3 μm spectral range in fibrecited 745x.This was the first experimental demonstration truly to reveal the potential of MIR fibres to emit across the MIR molecular "fingerprint spectral region" and a key first step towards bright, portable, broadband MIR sources for biomolecular sensing, including for cancer detection. I am elected Fellow of SPIE for special contribution to glass photonics, Fellow of the Society of Glass Technology, Fellow of the Institute of Materials, Minerals and Mining and Fellow of the Royal Society of Chemistry. 269 publications, 238 talks at conferences and institutions, including 100 invited.

SESSION SPEAKER

Haishan Zeng, PhD
University of British Columbia, Canada

In vivo multiphoton microscopy and multiphoton absorption based laser therapy

Biography

Dr. Haishan Zeng is a distinguished scientist with the Integrative Oncology Department (Imaging Unit) of the BC Cancer Research Centre and a professor of Dermatology, Pathology, and Physics at the University of British Columbia, Vancouver, Canada. For over 30 years, Dr. Zeng's research has been focused on the optical properties of biological tissues, light-tissue interaction, and nanomaterials enhanced light-tissue interaction as well as their applications in medical diagnosis and therapy. His group has pioneered the multiphoton absorption based laser therapy and is at the leading position in endoscopy imaging and Raman spectroscopy for in vivo early cancer detection, and silver/gold nanoparticles based surface enhanced Raman spectroscopy analysis of body fluids for cancer screening. He has published over 170 refereed journal papers, 17 book chapters, and 1 book ("Diagnostic Endoscopy", CRC Press Series in Medical Physics and Biomedical Engineering). Dr. Zeng serves as Editorial Board members for the Journal of Biomedical Optics and the recently launched Translational Biophotonics. He is an Executive Organizing Committee member of the annual SPIE International Symposium on Biomedical Optics. Dr. Zeng's research has generated 28 granted patents related to optical diagnosis and therapy. Several medical devices derived from these patents including fluorescence endoscopy (ONCO-LIFE™) and rapid Raman spectroscopy (Vita Imaging Aura™) have passed regulatory approvals and are currently in clinical uses around the world. The Aura™ device using Raman spectroscopy for non-invasive skin cancer detection was awarded the Prism Award in the Life Sciences and Biophotonics category in 2013 by SPIE - the International Society for Optics and Photonics.

SESSION SPEAKER

Lingyan Shi
Discoverer, Golden Optical Window,
UCSD Bioengineering, USA

KEYNOTE SPEAKER

Discoverer, Heavy water labeling a relatively new imaging method, stimulated Raman scattering microscopy

Understanding the dynamics of metabolism in a multicellular organism is essential to unraveling the mechanistic basis of many biological processes. It is the synthesis, transformation and degradation of biomolecules (the definition of metabolism) that carry out the genetic blueprint. Traditional imaging methods such as MRI, PET, Fluorescence, and Mass Spectrometry have fundamental limitations. Being an emerging non-linear vibrational imaging microscopy technique, stimulated Raman scattering (SRS) can generate chemical specific imaging with high resolution, deep penetration of depth, and quantitative capability. In the present work, we developed a new method that combines deuterium isotope probing and Stimulated Raman Scattering microscopy to visualize metabolic dynamics in live animals. The enzymatic incorporation of deuterium (D) into biomolecules will generate carbon-deuterium (C-D) bonds in macromolecules. Within the broad vibrational spectra of C-D bonds, we discover lipid-, protein-, and DNA-specific Raman shifts and develop spectral unmixing methods to obtain C-D signals with macromolecular selectivity. This technology platform is non-invasive, universal applicable, and it can be adapted into a broad range of biological studies such as development, aging, homeostasis, tumor progression, etc. We applied this method to study the myelination in the postnatal mouse brain, the identification of tumor boundaries, the intra-tumoral metabolic heterogeneity, and the differential protein/lipid metabolism during aging process.

Biography

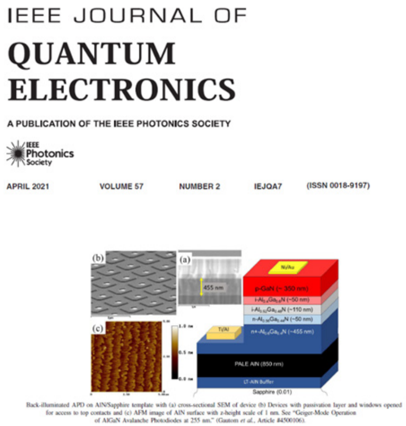
Dr. Lingyan Shi is an assistant Professor in the Department of Bioengineering at UCSD, her Lab is developing and applying novel optical imaging techniques for solving important biological questions. Her major achievements in scientific research include the discovery of the "Golden Optical Window" for deep brain imaging, and a breakthrough platform (DO-SRS) for high resolution optical imaging of metabolic activities in animals in situ. Dr. Shi has published 43 peer reviewed journal papers and has 6 awarded patents. She won the Blavatnik Regional Awards for Young Scientists in 2018. She received OSA Senior Member Designation in 2020 and was selected as an Advancing Bioimaging Scialog Fellow in 2021.

Geiger mode AlGaN UV APD with single photon detection

Lakshay Gautam, Manijeh Razeghi*
Northwestern University, United States

STUDENTS

Solar-blind photo detectors find applications in a host of different fields such as early missile detection systems, flame line monitoring, biological agent detection etc. However, these applications require extremely sensitive photodetectors which are capable of sensing single photon detection. This talk will shed light on our current work involving Geiger mode AlGaN based UV avalanche photodetectors operating in the solar-blind window with high gains (~50,000) and single photo detection capabilities. These photodetectors have the potential to replace existing Photomultiplier Tubes (PMTs) which are bulky and fragile with an efficient and compact solid- state solution in the form of high performance AlGaN based UV APDs.



[1]*(Corresponding author) Manijeh Razeghi is with the Northwestern University, Evanston, IL 60208 USA.

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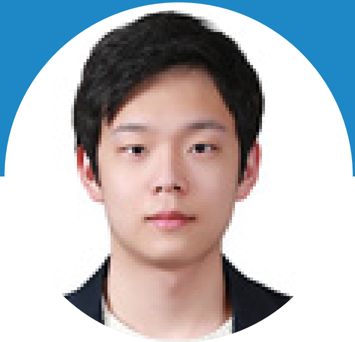
Femtosecond Conical Emission in BK-7 Glass and the Influence of the Transient Kerr Nonlinear Index

Henry J. Meyer and Robert R. Alfano

Institute for Ultrafast Spectroscopy and Lasers,
Department of Physics, The City College of the New York, United States

The angle of Conical Emission (CE) was measured using a 50 fs 800 nm laser in BK-7 glass. The result covers a long-range emission range of +9000 to -2000 cm-1. This span encompasses both degenerate Anti-Stokes and Stokes emission, as well as non-degenerate angular emission at the source wavelength. The resulting angle is compared to three different mathematical models of CE. In all three emission windows the Alfano-Shapiro model from 1970 outperforms both the X-Wave model as well as the Luther Four Wave Mixing model. Following the Alfano-Shapiro model the measured non-degenerate emission is directly related to the Kerr nonlinear index. The presented fitting result confirms that for a 50 fs pulse the Kerr index has transition into its pure electronic state, as incorporating the slower material components breaks the agreement with the model. The near perfect fit between the Alfano-Shapiro model and the experimental results suggests that the method outlined here could be used as a new easy way to measure the Kerr nonlinear index.

STUDENTS



Si-doped p-type Ga_2O_3 grown by MOCVD and its field-effect transistors

Junhee Lee[1] and Manijeh Razeghi[1*]
[1]Center for Quantum Devices, Northwestern University, United States

Gallium oxide (Ga2O3) has been regarded as a promising next-generation material due to its wide bandgap of ~4.8 eV, competitive mobility (~100 cm2/Vs), and high breakdown fields in the range of ~8-9 MV/cm. These superior characteristics, especially breakdown field, are significantly higher than gallium nitride (GaN) or silicon carbide (SiC) commonly used in today's power transistors. In spite of its promise, an advancement of Ga2O3 has been hampered by the inability to dope with acceptors and generate p-type material. In order to make further progess, thorough understanding of p-type doping mechanism is required. In this work, we demonstrate that silicon can play an amphoteric behavior, making Ga2O3 have p-type conductivity when silicon substituted in oxygen positions as a double acceptor. Both hall measurement and transfer curve of field-effect transistors (FETs) show that the Si-doped Ga2O3 layers, grown by metal organic chemical vapor deposition (MOCVD), can yield p-type electrical characteristics. Our finiding highlights that p-type Ga2O3 can be achieved by silicon doping and thus Ga2O3-based electronics hold great promise for widespread industrial applications.

Biography

Junhee Lee is currently pursuing a Ph.D. degree at the Center for Quantum Devices, Northwestern University. He involved in the development and fabrication of n- and p-type Ga2O3 devices and III-Nitrides. His research interests lie on wide bandgap metal oxide semiconductors.

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STUDENTS

Optical Simulation Tool for SDM Communication System based on Off-Axis Parabolic Mirror

Ce Su and Syed H. Murshid
Optronics Laboratory, Florida Institute of Technology, United States

Spatial Domain Multiplexing (SDM) is a multi-input multi-output (MIMO) architecture. SDM utilizes radially distributed spatial locations for different input signals based on their input launch angles. These input channels propagate in a helical path inside the carrier fiber and do not encounter any perceptible crosstalk or inter-symbol interference. The SDM system is like other optical communication systems. However, they require two added parts. These parts are the spatial multiplexer, known as the Beam Combiner Module (BCM), and the de-multiplexer, better known as the Beam Separator Module (BSM). A robust and reliable BCM is critical for spatial domain multiplexing technology.

The BCM uses an Off-Axis Parabolic (OAP) mirror, and the angle between the focused beam and the collimated path is 90°. The mirror is a segment of a parent paraboloid reflecting surface, which focuses on a collimated beam while the off-axis configuration separates the focal point from the beam path. A simple way to model the propagation of optical energy in a fiber is to use the ray theory approach. With fixed optical components, like an OAP-based BCM, ray theory can predict the output pattern. A ray theory based mathematical model incorporating the OAP based SDM system named "90° Off-Axis Parabolic Mirror Based BCM for SDM Pattern Calculation" is implemented LOPS 2021 in MATLAB based software to perform calculations and to predict the output pattern in a quick and accurate fashion. The software used for this purpose utilizes the MATLAB App Designer programming environment. The final product can run on Windows, Linux, Mac, and other web server-based environments. The software is open-source, and it is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, and it is available at https://sites.google.com/my.fit.edu/optronics/current-research-focus/sdm.

The software developed for this purpose predicts the output patterns accurately, and its dedicated nature allows it to perform better than commercially available general-purpose simulation tools.

STUDENTS

International Scientific Conference on
LASERS, OPTICS, PHOTONICS AND SENSORS

Analysis of SDM Optical Communications System Using Optisystem and Zemax

Mingxuan Tu, Swaroopini Harish, Ce Su, and Syed Murshid
Optronics Laboratory, ECE Department, Florida Institute of Technology, United States

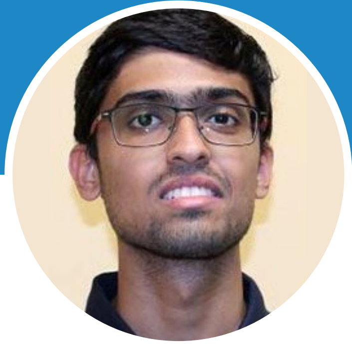
STUDENTS

Spatial Domain Multiplexing (SDM) is a multiple-input-multiple-output (MIMO) multiplexing technique that uses the spatial freedom of photons inside optical fibers to increase the data transmission capacity. Each channel travels the length of a carrier fiber traversing an independent helical path independently and do not interfere with each other. The output of SDM channels is in the form of concentric rings. These rings can be represented by the Laguerre-Gaussian (LG) model.

This endeavor presents a simulation of a four-channel SDM system to effectively quadruple the data transmission rate of the optical channel. Zemax tools are used to model the multiplexer and demultiplexer of the SDM system, while OptiSystem based simulation is used to

analyze the operation of the communications link. The Zemax simulation of the multiplexer and demultiplexer modules ensures that an experimental SDM system can be realized using a similar topology. In the Zemax simulation, four input sources are launched into the carrier fiber at different input angles corresponding to their topological values. The demultiplexer module utilizes mirrors with holes to spatially filter the SDM rings.

In the Optisystem simulation, four laser diodes carrying non-return-to-zero (NRZ) pseudo random bits will go through the LG mode generator to realize Zeroth order LG mode patterns with different topological charges for the different channels. The four channels are multiplexed together and coupled to a multimode carrier fiber. At the output end, four donut-shaped SDM rings can be viewed using a spatial visualizer and can be separated via spatial demultiplexer and forwarded to the spatial optical receiver module for subsequent detection and processing. This endeavor presents simulated data of a SDM optical communication system based on LG model using Optisystem simulation engine. Optical properties of the system including wavelength dependency of bit-error-rate (BER) and Q factor are presented and analyzed.



PAM-4 Data Transmission using Modulation Instability Frequency Combs on a Kerr Microresonator platform

Chinmay Shirpurkar
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Optical frequency combs have found their applications in many areas over the past decade. One type of comb generation observed in microresonators which relies on the Kerr effect has been of particular interest in many areas of ultrafast optics due to the advantages of having a broad comb bandwidth and low threshold powers for parametric gain. These Kerr optical frequency combs have been used in a wide variety of applications including spectroscopy, frequency metrology, LIDAR, microwave to optical links and optical communication. In this work, we demonstrate an application of optical communication by creating a communications link consisting of a data transmitter and receiver. The optical carrier signals are generated by pumping a microresonator ring and accessing the Kerr optical frequency comb. The comb states can be classified into the MI comb states and the soliton comb states. The individual wavelengths of the soliton frequency comb are demultiplexed and modulated with a PAM-4 modulation scheme using an electro-optic intensity modulator. We multiplex these different carriers again and send it through optical fiber. At the output we again demultiplex the carriers, receive the transmitted signals and make an estimate of the BER of the received data by considering the eye diagrams of the signals.

The Kerr microresonator used in our experiments has an FSR of 300 GHz and spans a bandwidth of about 35 THz which generates about 120 different optical frequencies. Considering a 40 Gbps PAM-4 data transmission rate (generated by 1Gbps of NRZ signals) on a single channel, it would be possible to transmit over 520 Gbps through this single optical communications link for the 13 channels. Higher transmission rates can be achieved by higher RF modulation data rates or more number of channels (achieved by interleaving two separate combs or reducing FSRs). This large bandwidth combined with the stability of these combs make them an extremely attractive platform for transmission of data at high rates with low BERs.

Biography

Chinmay Shirpurkar has completed his Bachelor of Technology in Electrical Engineering from the Indian Institute of Technology, Gandhinagar and is currently pursuing a PhD. in Optics and Photonics from the College of Optics & Photonics (CREOL) at the University of Central Florida. His research interests include ultrafast photonics, metrology and optical communications.

Performance of a real-time atmospheric turbulence compensation methodology operating on aberrations modeled with Von Karman statistics

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The Well Optimized Linear Finder (WOLF) method is a novel, non-iterative deconvolution method implemented to correct atmospheric and system phase disturbances in optical systems using diversity-based incoherent image irradiance data. The WOLF method addresses the problem of turbulent atmosphere limiting spatial resolution for long-range optical imaging systems having sufficiently large entrance pupil plane apertures such as those in telescopic imaging systems, especially in real-time operation. Developed by Dr. William Arrasmith at the Florida Institute of Technology, the WOLF method exploits symmetries and entrance pupil plane phase redundancies in the discrete convolution of the generalized pupil function to estimate the optimal Optical Transfer Function (OTF). Simultaneously, entrance pupil plane phase disturbances due to the atmospheric aberrations are estimated and used to point-wise estimate the aberration-free object radiant emittance. The sub-algorithms use a novel error metric for generating estimates in the WOLF method. Herein is a qualitative and quantitative investigation in application of the Von Karman stochastic definition to generate representative discrete atmospheric-turbulence-induced phase aberrations for simulated diversity images of an incoherent optical imaging system as input to WOLF method simulations. The Von Karman stochastic definition has advantage over Kolmogorov models in its ability to represent a larger range of atmospheric scale lengths and application to temporal statistics. We also include the effects of optical system noise with addition of Gaussian white noise to demonstrate the efficacy of the WOLF method in application to real-world atmospheric turbulence compensation (ATC).

Key Words: Von Karman Spectrum, Atmospheric Turbulence Compensation, Atmospheric Turbulence Modeling, Blind Deconvolution, Imaging, Image Processing, Blind Deconvolution

STUDENTS

Infrasound to Optics: System Noise Reduction Using New M.I.D.A.S. Filter With Wavelet-based Pre-Processor

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The ever-present challenge faced by the signal processing analyst is to get more from the available data, whether it be exploiting the same data in new ways to garner new information, or simply to increase the confidence in existing qualitative metrics. Traditional techniques include filtering (to improve the signal to noise ratio or to isolate and possibly remove interfering signals), feature detection/extraction (identifying key characteristics within the signal) and signal decomposition (identification of dominant signals of interest relative to noise terms). Current research by our team began with an emphasis on the filtering of signals of interest within the infrasound band but has been shown to also be effective in other applications including image processing. The Multi-band Isolation of Signals using Data-Adaptive Sub-banding (M.I.D.A.S.) filter begins with a wavelet pre-processing stage and follows with a spectral sub-banding stage for isolation of key signal content. The MIDAS filter is a coherent filter, so the filtering of a complex input produces a phase-preserved complex output. With many other infrasound and seismic data filtering tools such as the Pure State Filter, a real-valued input is required and thus no phase information can be extracted from the data set. A presented signal processing scenario where phase preservation is critical is image processing. A qualitative and quantitative assessment of image quality metrics suggests the MIDAS filter is effective at removing channel noise-type artifacts from images while preserving the phase information.

Keywords: signal processing, image processing, infrasound data analysis

STUDENTS

Well Optimized Linear Finder (WOLF) Atmospheric Turbulence Compensation (ATC) computational speed improvement through the adoption of parallel, pre-calculated constant complex exponential phase difference chains.

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The Well-Optimized Linear Finder (WOLF) high-speed, phase-dominant, transfer function estimation method, developed by Professor William W. Arrasmith at Florida Institute of Technology, is a novel, high-speed, transfer function estimation method that, among other things, can be applied to atmospheric turbulence compensation (ATC)/blind deconvolution optical imaging problems. The WOLF methodology uses a diversity-based approach and an adapted error metric to quickly remove the effects of atmospheric turbulence and system noise effects that are present in an incoherent, optical imaging system. In our research, we improve the performance of the WOLF algorithm by investigating the impact of applying parallel processing technology to pre-calculate an expanding set of constant complex exponential phase difference sums that lie at the core of the WOLF methodology. Depending on the number of entrance pupil plane sample points in the image, these complex exponential phase differences can range from an initial single complex exponential phase difference term to sums of millions of complex exponential phase difference terms. We use order analysis on the WOLF algorithm to evaluate the theoretical implications of pre-calculating the constant exponential phase difference chain terms in parallel, and in advance, of when they are needed. We validate the theoretical predictions by using computer simulations to isolate the timing associated with the determination of the constant complex exponential phase difference terms and show that a conservative estimate of approximately 18 percent faster performance can be achieved by just implementing the pre-calculation of the sums of constant complex exponential phase difference terms themselves. A representative 256 x 256-pixel image was used in our analysis and computer simulation. The computer used in the study was an un-modified 2014 MacBook Pro computer with a 2.8 GHz (Quad-Core, Intel Core i7) with 16 GB of 1600 MHz DDR3 memory, and a NVIDIA GeForce GT 750M 2 GB video card running Matlab 2020b. Removing the atmospheric turbulence from the 256 x 256 image took approximately 8 seconds with the nonoptimized WOLF algorithm without taking advantage of parallel processing, or the precalculation of the constant complex exponential phase difference terms.

Keywords: Atmospheric Turbulence Compensation, Image Processing, Blind Deconvolution, Image restoration, High Spatial Resolution Imaging, Incoherent Imaging

STUDENTS

Order Analysis Comparison between traditional Fourier Transform-based atmospheric turbulence compensation methods and new Well Optimized Linear Finder Methodology

Atmospheric Turbulence Compensation (ATC) methods have long been used to remove atmospheric turbulence effects from optical imaging systems. Traditional ATC methods were predominantly implemented in software and were generally slow with ATC taking hours to days for images with relatively small number of pixels. Recently, the Well Optimized Linear Finder (WOLF) methodology has been developed for high-speed, diversity-based and phase-dominant, transfer function estimation problems across the electromagnetic and acoustic spectrum. Consequently, the WOLF paradigm has direct relevance to ATC problems for imaging systems. The WOLF methodology, developed by Professor William W. Arrasmith at the Florida Institute of Technology is orders of magnitude faster and more accurate than traditional, iterative ATC methods. The WOLF algorithm applies to diversity-based ATC methods and similarly can be implemented largely in software. In this study we use complexity analysis to theoretically compare the WOLF paradigm to traditional diversity-based ATC methods and validate our theoretical results using computer simulation. We analyze the computational complexity by using order analysis and also by comparing the number of elementary operations of a traditional ATC method with the new WOLF paradigm. Both approaches show that the WOLF paradigm is orders of magnitude faster than traditional ATC methods on conventional laptop and desktop computers. The WOLF paradigm can also be implemented using parallel processing technology such as using the Graphical Processing Unit (GPU) on standard computers/laptops, or Field Programmable Gated Arrays (FPGAs), and is expected to exceed the computational speed performance of traditional ATC methods on comparable single processor or parallel processing devices. Computer timing and scaling simulations were run on a 2014 MacBook Pro Laptop with a 2.8 GHz Quad-Core Intel Core i7 processor, 16 GB 1600 MHz DDR3 memory, and a NVIDIA GeForce GT 750M 2 GB graphics card and confirm our theoretical results from small 5 x 5 images/image segments up to 4 mega-pixel images.

Keywords: Atmospheric Turbulence Compensation, Blind Deconvolution, Object Reconstruction, Image Processing, Transfer Function Estimation

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STUDENTS

A unified platform for simulating light transport in turbid media and its applications in Optical Diagnostics, Sensing and Computer Graphics

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SPEAKER

This talk considers development of a unified platform for simulating light transport in turbid media and its practical use in a variety of applications including novel Optical Diagnostics, Sensing and Computer Graphics modalities empowered by the Machine Learning (ML) techniques. We present an online browser-based solution and a Monte Carlo model which considers geometrical, spatial, and volumetric variations e.g. surface roughness and subsurface scattering properties of turbid media. The model is accelerated by parallel programming frameworks developed in-house and is being extensively utilized in the ongoing studies of light transport in turbid media. Particular examples include: in situ estimation of certain specific tissue parameters of interest such as distributions of melanin, blood, oxygenation, etc.; simulation of propagation of both spin and the orbital angular momentum of light; biophysically based 3D computer graphics renderings of human skin appearance, etc. The prototypes of lightweight sensing/visualization solutions that could potentially be shrank onto a smartphone/wearable device form-factor will be presented and rigorous validation against experimental data will be discussed.

Biography

Dr Alexander Doronin is an Assistant Professor in Computer Science at Victoria University of Wellington (New Zealand). His research interests are interdisciplinary and lie at the interface between Computer Graphics, Biomedical Optics and most recently Artificial Intelligence focusing on modelling of light transport in turbid media, development of novel optical diagnostics modalities, physically-based rendering, optical measurements/instrumentation, acquisition and building of realistic material models, colour perception, translucency, appearance and biomedical visualization. He has extensive recognized experience in the design of forward and inverse algorithms of light scattering in turbid tissue-like media simulations and created a generalized Monte Carlo model of photon migration which has found a widespread application as an open-access computational tool for the needs of light transport communities in Biophotonics, Biomedical Imaging and Graphics.

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