

Optical Remote Sensing of the Environment (ORS)

June 7-8, 2010, The Westin La Paloma, Tucson, AZ, USA

The scope of the Optical Remote Sensing of the Environment Conference will focus on three general areas: sensors, algorithms and phenomena, and applications. With regard to sensors, the conference will focus especially on hyperspectral and multi-spectral imaging sensors, LiDAR, and multi-sensor imaging (for example, hyperspectral combined with LiDAR or hyperspectral and other non-optical remote sensing modalities such as RADAR).

Under the general area of algorithms and phenomena, papers will focus on topics such as methods to correct data (atmospheric correction), exploitation methods using a variety of methods (for example radiative transfer and image classification, detection, or change detection methodologies). Papers will also address specific topics related to retrievals such as ocean color and land biophysical or geophysical parameters. Other analysis techniques and tools will also be covered, for example, compression, sensor fusion, and data visualization and GIS/information management.

Application topics will address a broad range of topics where optical sensors are used to characterize the environment, such as the coastal ocean, forestry, agriculture, or environmental monitoring and natural resource monitoring and management. [Learn more.](#)

Pre-Registration is now closed. You may still register on-site at the Westin La Paloma in the Lobby Foyer (Tucson, Arizona) beginning Sunday, June 6.

Take advantage of all ORS has to offer:

- [Six meetings for the price of one](#)
- [Tabletop exhibit](#)
- [Short course for professional development](#)
- Poster sessions providing one-on-one discussion time with presenters
- [Networking events](#)

Conference Program

[View the Agenda
Plan Your Conference](#)

[View](#) the conference program and plan your itinerary for the conference

- Browse speakers and the agenda of sessions
- Browse sessions by type or day.
- Use Advanced Search to search by author, title, OCIS code and more.
- Plan and print your personal itinerary before coming to the conference.
- Download your personal itinerary to your mobile device.
- Add your personal itinerary to your electronic calendar.
- Email your itinerary to a colleague who might be interested in attending.

Download pages from the Congress program book (includes all meetings in the Imaging and Applied Optics Congress)!

- [Abstracts pdf](#)
- [Agenda of Sessions pdf](#)
- [Key to Authors and Presiders pdf](#)
- [Postdeadline Paper Abstracts \(pdf\)](#)
- [Postdeadline Paper Key to Authors \(pdf\)](#)

[Special Opportunities](#)- for Students and Young Professionals

Imaging and Applied Optics Congress: OSA Optics & Photonics Congress

- [Applied Industrial Optics: Spectroscopy, Imaging and Metrology \(AIO\)](#)
- [Digital Image Processing and Analysis \(DIPA\)](#)
- [Imaging Systems \(IS\)](#)
- [Optical Remote Sensing of the Environment \(ORS\)](#)
- [Optics for Solar Energy \(SOLAR\)](#)
- [Photonic Metamaterials and Plasmonics \(META\)](#)

Special Events [Details](#)

- Welcome Reception
- Panel Session
- Plenary Session
- Post Deadline Paper Session
- Tour of the University of Arizona
- OSA/MIT CIPS Short Course Videocast

Sponsor:



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Program

The program for Optical Remote Sensing of the Environment (ORS) Monday, June 7 through Tuesday, June 8. No events are scheduled for Sunday, June 6; however participants may register and pick up their materials on Sunday afternoon.

- [Online conference program](#)
- [Download pages from the program book](#)
- [About the meeting topics](#)
- [Download pages from the program book](#)
- [Invited speakers](#)
- [Call for papers \(pdf\)](#)
- [Special events](#)

Online Conference Program

[Searchable Conference Program Available Online!](#)

- Browse speakers and the [agenda of sessions](#).
- Browse sessions by type or day.
- Use Advanced Search to search the program by author, title, OCIS code and more.
- Plan and print your personal itinerary before coming to the conference.
- Download your personal itinerary to your mobile device.
- Add your personal itinerary to your electronic calendar.
- Email your itinerary to a colleague who might be interested in attending.

You may search the program without creating an account; however, you will not be able to create or save a personal itinerary without first creating an account. We strongly recommend that you create a user account first.

[View the Agenda
Plan Your Conference](#)

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Download pages from the program book!

- [Agenda of sessions \(pdf\)](#)
- [Abstracts \(pdf\)](#)
- [Key to authors and presidors \(pdf\)](#)

About Optical Remote Sensing of the Environment

Optical remote sensing of the environment addresses many needs in both civilian and military sectors. The scope of the Optical Remote Sensing of the Environment Conference will focus on three general areas: sensors, algorithms and phenomena, and applications. With regard to sensors, the conference will focus especially on hyperspectral and multi-spectral imaging sensors, LiDAR, and multi-sensor imaging (for example, hyperspectral combined with LiDAR or hyperspectral and other non-optical remote sensing modalities such as RADAR).

Under the general area of algorithms and phenomena, papers will focus on topics such as methods to correct data (atmospheric correction), exploitation methods using a variety of methods (for example radiative transfer and image classification, detection, or change detection methodologies). Papers will also address specific topics related to retrievals such as ocean color and land

biophysical or geophysical parameters. Other analysis techniques and tools will also be covered, for example, compression, sensor fusion, and data visualization and GIS/information management.

Application topics will address a broad range of topics where optical sensors are used to characterize the environment, such as the coastal ocean, forestry, agriculture, or environmental monitoring and natural resource monitoring and management.

Papers were considered in the following topic categories:

- **Sensors**
 - ▼ Hyperspectral
 - ▼ Multi-spectral
 - ▼ LIDAR
 - ▼ Multi-sensor (optical + radar/SAR, LIDAR + HIS, airborne + satellite)
- **Applications**
 - ▼ Coastal/Ocean
 - ▼ Forestry
 - ▼ Geology/Soils
 - ▼ Agriculture
 - ▼ Land Use/Land Cover
 - ▼ Water Resource Monitoring/Management
 - ▼ Wildlife Ecology
 - ▼ Wetlands
 - ▼ Environmental Monitoring/Assessment
 - ▼ Urban and Regional Planning
- **Algorithms & Phenomena**
 - ▼ Radiative Transfer (general)
 - ▼ Atmospheric Correction
 - ▼ Ocean Color and Hyperspectral/Multi-spectral
 - ▼ Sensor Fusion
 - ▼ Detection/Change Detection
 - ▼ Image Classification
 - ▼ Compression
 - ▼ Data Visualization, Modeling, and Information Management and Dissemination
 - ▼ GIS and Data Fusion
 - ▼ Numerical Modeling and Simulation

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Download Pages from the Program Book!

- [Agenda of sessions \(pdf\)](#)
- [Abstracts \(pdf\)](#)
- [Authors and presenters \(pdf\)](#)

Special Events

For more information visit the [Imaging Congress special events page](#).

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Optical Remote Sensing of the Environment (ORS)

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Chairs & Committee Members

The Technical Program Chairs and Committee Members are integral to the success of the meeting. These volunteers dedicate countless hours to planning, including such critical activities as raising funds to support the event, securing invited speakers, reaching out to colleagues to encourage submissions, reviewing papers, and scheduling sessions. On behalf of OSA, its Board, and its entire staff, we extend enormous gratitude to the following members of the Optical Remote Sensing of the Environment (ORS) Technical Program Committee.

[Program Committee](#)

[Information for Conference Chairs and Committee Members](#)

[Information for Session Chairs/Presiders](#)

Program Committee

General Chairs

- Charles M. Bachmann, *NRL, USA*
- Melba Crawford, *Purdue Univ., USA*

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- Marcos Montes, *NRL, USA*
- Reid Nichols, *Marine Information Resources Corp., USA*
- Dar Roberts, *Univ. of California at Santa Barbara, USA*
- Jan van Aardt, *RIT, USA*

If you are a member of the committee and have any questions or concerns at any point along the way, please refer to the information below or contact your [program manager](#).

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Information for Conference Chairs and Committee Members

- View the [Calendar of Deadlines for the Meeting \(pdf\)](#)
- View the [Chairs' Manual \(pdf\)](#)
- View the [Call for Papers \(pdf\)](#)
- View [Fundraising Information \(pdf\)](#)
- View [Exhibit and Sponsorship Information](#)

- View [Author/Presenter Information](#)
- View [Peer Review Instructions \(pdf\)](#)
- View [Scheduling Instructions \(pdf\)](#)
- View [Student Travel Grant Information](#)
- View [Registration Information](#)
- View [Housing Information](#)

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Information for Session Chairs/Presiders

The role of the session presider (or session chair) is an important one. In many ways, the success of the session and the presentations within it depends on the presider. First and foremost, OSA recognizes the significance of the role of the session presider, and we thank you for volunteering to serve in this critical role!

The information on this page is arranged in the following sections and is intended to assist you in managing a successful session:

- [Arriving at Your Session Room](#)
- [Guidelines for Presiding over a Session](#)
- [Completing the Presider Check-in Sheet](#)

Arriving at Your Session Room

Presiders are requested to identify themselves to the audiovisual personnel at least 20 minutes before the session begins for a quick review of equipment and procedures.

Guidelines for Presiding over a Session

Remember to introduce yourself as the presider and announce the session. The total amount of time allotted for each presentation is listed in the online program as well as in the conference program book, and start times for each presentation are listed on the presider check-in sheet at the podium. A 60-minute mechanical timer will be available for your use. We recommend that the timer is set two minutes prior to the end of the presentation time in order to provide a warning to wrap up the talk and start the discussion period. Notify the authors of this warning system. It is also important to remind the speaker to repeat the questions asked from the audience.

Maintaining the scheduled timing of papers is very important. In cases where the paper is withdrawn or the speaker does not show, use the time for an extended question period for authors of previously presented papers or call a break. PLEASE DO NOT START TALKS EARLIER THAN THEY ARE SCHEDULED. All requests to modify the program schedule should be directed to the program chair.

We will have presider check-in sheets in your session room to complete and return to management at the completion of your session. When monitoring the session we ask that you note any changes or no-shows on this sheet for our records.

IMPORTANT NOTICE: Due to licensing restrictions, the use of music in presentations, including video presentations, is prohibited. If a speaker uses music during his/her presentation, please inform Meeting Management immediately.

For additional tips on how to be a great presider, [watch a video](#) featuring Dr. Ben Eggleton (CUDOS, Univ. of Sydney, Australia), or [read the notes \(pdf\)](#) detailing a few of Dr. Eggleton's most important points.

Completing the Presider Check-in Sheet

Once you arrive at your session room, you will find a folder marked "Presider Check-In" at the podium or on the table at the front of the room. This folder will contain a sheet for each session in that room. Please be sure to remove only the sheet that applies to the session you are chairing, and leave the others in the folder. The check-in sheet will list the talks within your session, the order in which they will be given, and the name of the author giving the presentation. Please complete the check-in form as follows:

- Estimate the number of attendees in the session at the start of the session, about halfway into the session, and at the end of the session; note these counts where indicated in the upper right corner.
- Check the box in the rightmost column to indicate which speakers presented during the session.
- Make note of any no-show speakers or replacement speakers.

- Leave the completed sheet in the folder in the pocket marked “Completed.”
- Leave the folder on the podium or table for the next session presider. (If you are chairing the last session of the day, please leave the folder in the room for meeting management.)

The check-in form serves two purposes: 1) to assist you in running an effective session and 2) to help OSA ensure that the appropriate speakers' files are archived on OSA Optics InfoBase after the meeting. Only those authors who attend and present are included in the InfoBase, so it's important that you make note of any presenters who are absent.

[View a sample check-in sheet \(pdf\).](#)

Again, we appreciate your assistance in serving as a session presider!

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Imaging and Applied Optics: OSA Optics & Photonics Congress

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Exhibit

OSA Congresses are unique, medium sized meetings where 300-500 industry experts and top researchers and developers share their latest research and collaborate on new and future applications within their specialized fields. The meetings focus on the most advanced developments within specific topical areas of the optics and photonics industry. Exhibiting at The OSA Imaging and Applied Optics Congress offers you an extremely targeted opportunity to display your company's products that fall within these co-located topical meeting areas:

- [Applied Industrial Optics: Spectroscopy, Imaging, and Metrology \(AIO\)](#) **New!**
- [Digital Image Processing and Analysis \(DIPA\)](#) **New!**
- [Imaging Systems \(IS\)](#) **New!**
- [Optical Remote Sensing of the Environment \(ORS\)](#)
- [Optics for Solar Energy \(SOLAR\)](#) **New!**
- [Photonic Metamaterials and Plasmonics \(META\)](#)

Current Exhibitor List (as of May 25, 2010)

Alternative Vision Corp
Avo Photonics
Catalina Scientific Instruments
Deposition Sciences
Nanoplus
Optical Perspectives Group
Optimax
Veeco

[Reserve Your Exhibit Space](#)

Bonus: You will receive one free technical pass for every tabletop space or 10'x10' booth you purchase.

[Exhibit Rates](#)

[Sponsorship Opportunities](#) for OSA Optics and Photonics Congresses

[Full List of OSA Exhibiting Opportunities](#)

For More Information about Reserving Exhibit Space at OSA Meetings, please call +1 202.416.1474 or email exhibitsales@osa.org

[Exhibitor Service Manual](#) (includes set-up times, registration instructions, checklist of deadlines and shipping instructions)

For additional questions about exhibit logistics, please call +1 202-416-1972 or topicalexhibits@osa.org.

Imaging and Applied Optics Congress 2010

Applied Industrial Optics: Spectroscopy, Imaging
and Metrology (AIO)
Digital Image Processing and Analysis (DIPA)
Imaging Systems (IS)
Photonic Metamaterials and Plasmonics (META)
Optical Remote Sensing of the Environment (ORS)
Optics for Solar Energy (SOLAR)

Tucson, Arizona



June 7-9, 2010

Alternative Vision Corporation

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Alternative Vision Corporation is a value-added reseller of high-performance imaging components and equipment to OEMs and systems integrators. Our current product lines include stock and custom monochrome and color cameras, smart cameras, vision processors, stock and custom CMOS image sensors, sensor sockets, manual and motorized NIR/SWIR/MWIR/LWIR infrared lenses, 2-5 port spectral separation prisms, laser welding and cutting optics, finite-conjugate optics, optical design services and a selection of unique optical components.

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Avo Photonics provides Custom Design and advanced Contract Manufacturing services to opto-electronic customers in the medical, military, aerospace, communications, and industrial markets. Avo's Packaging services provide customers with support throughout all stages of the product lifecycle – Concept thru Prototype and into Production. Avo Photonics' personnel and equipment are an extension of its customer's business, providing transparent services at the low to high volumes required.

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nanoplus is a worldwide leader in the production and distribution of: DFB and Fabry Perot laser diodes from 750 nm to 2900 nm, quantum cascade lasers from 5 µm to 14 µm and superluminescent diodes. They allow precise sensing applications in the fields of e. g. remote gas sensing, precision metrology, process control and atomic clocks.



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Optical Perspectives Group, LLC is a consulting firm specializing in the hardware aspects of optics, particularly the fabrication, testing, assembly and alignment of optical components and systems. In support of these functions, OPG markets two products; the Point Source Microscope (PSM) used for the alignment of optics and optical systems, and the CaliBall, an artifact used for calibrating interferometer transmission spheres using the random ball test.



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Special Events

OSA/MIT CIPS Short Course Videocast

Monday, June 7, 2010
8:00 a.m.-2:00 p.m.

Course held in conjunction with OSA Solar Energy Meeting of June 8-8, 2010 -Explore the rapidly expanding roles of optics and photonics in solar energy generation.

This course is intended for researchers, engineers, graduate students and other technologists who wish to enhance their knowledge in the solar and optics/photonics fields. No expertise in the course topics is assumed.

Instructors will include

- Prof. Marc Baldo, MIT- Solar Energy Tutorial
- Prof. Tonio Buonassisi, MIT- Silicon Photovoltaics
- Prof. Vladimir Bulovic, MIT- Thin-film Photovoltaics

Click for [Short Course](#) details and [Registration](#) information.

Joint Welcome Reception

Monday, June 7, 2010
7:00 p.m.-8:30 p.m.

Start the Congress excitement early by joining us on Monday, June 7th, for the Welcome Reception. This reception is the perfect kick-off to this year's congress. Free to all Technical Conference Attendees. Meet with colleagues from around the world. Light hors d'oeuvres will be served.

Poster Sessions

Tuesday, June 8, 2010
2:00 p.m. – 4:00 p.m. and
7:00 p.m. – 7:45 p.m.

Poster presentations offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. During afternoon poster session, posters will be presented from the AIO, IS, META and ORS meetings. The evening poster session will highlight the Solar meeting poster presentations.

University of Arizona, College of Optical Science Tour

Tuesday, June 8, 2010
7:00 pm – 8:00 pm

Location:

Tour Begins in the West Wing of the Optical Sciences Building

Transportation:

6:30 pm – The bus departs from Westin La Paloma

8:15 pm - The bus will depart from to the University to the Westin La Paloma.

Please note: Limited Space available.

Self Transportation:

Parking is available in the Cherry Avenue parking structure, just south of the Optical Sciences Building

For those who will be driving, additional directions and parking information are available at:

<http://www.optics.arizona.edu/Maps/Default.htm>

As an attendee of the Imaging and Applied Optics Congress, you are invited to take a tour of the internationally renowned University of Arizona College of Optical Sciences. The College, the largest institute for optics education in the United States, is dedicated to research and education in all areas of optics.

The College of Optical Sciences, founded as the Optical Sciences Center, has been shaping the future since 1964 by offering highest-quality, on-campus and on-line graduate and undergraduate education, cutting-edge research programs, and a solid commitment to the economic development of the optics industry. The College focuses on providing solutions for the optics industry worldwide by initiating internationally recognized research programs and offering more than 90 courses in optical sciences.

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Invited Speakers

- OMA2, **Detailed Terrain Characterization from a Space Based Imaging Spectrometer**, *Thomas W. Cooley*; AFRL, USA
- OMA4, **The Hyperspectral Imager for the Coastal Ocean (HICO) and Environmental Characterization of the Coastal Zone from the International Space Station**, *Michael Corson¹, Robert L. Lucke¹, Curtiss O. Davis²*; ¹US NRL, USA, ²Oregon State Univ., USA
- OMB1, **Coastal Features and River Plumes as Seen with the Hyperspectral Imager for the Coastal Ocean (HICO)**, *Curt O. Davis¹, Robert Arnone², Richard Gould², Michael R. Corson³, Marcos Montes³*; ¹Oregon State Univ., USA, ²US NRL, Stennis Space Ctr., USA, ³US NRL, USA
- OMB4, **Bringing All Lidar Data Together: Investigations of Spatially Coincident Terrestrial, Airborne, and Satellite Lidar Data for Deriving Vegetation Structure Metrics**, *Sorin Popescu*; Texas A&M Univ., USA
- OMC4, **Simulating an Airborne Lidar Bathymetry (ALB) System**, *Schachak Pe'eri, Amaresh M. V. Kumar, Brian R. Calder*; Univ. of New Hampshire, USA
- OTuA1, **Multi-Source Geospatial Information Integration and Analysis for Coastal Management and Decision Making**, *Rongxing Li*; Ohio State Univ., USA
- OTuA2, **Assessing the Extent of Conservation Tillage Using Hyperspectral Imaging**, *Craig Daughtry, Guy Serbin, P. C. Doraiswamy, J. B. Reeves III, E. R. Hunt, Jr.*; US Dept. of Agriculture, USA, ASRC Management Service, USA, US Dept. of Agriculture, USA
- OTuA3, **Mapping Coastal Wetlands Using Small-Footprint, Green-Wavelength Lidar**, *Amar Nayegandhi*; Jacobs Technology Inc., US Geological Florida Integrated Science Ctr., USA
- OTuB2, **Evaluating Materials of Environmental Concern Using Hyperspectral Imaging**, *Gregg Swayze*; US Geological Survey Spectroscopy Lab, USA

Agenda of Sessions — Sunday, June 6

3:00 p.m.– 6:00 p.m.	Registration Open, Lobby Foyer
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— Monday, June 7

	Sonoran I	Murphey I & II	Sonoran II	Canyon I	Finger Rock	Canyon III
	AIO	DIPA	IS	META	ORS	SOLAR
7:00 a.m.– 6:00 p.m.	Registration Open, Lobby Foyer					
7:45 a.m.– 8:00 a.m.		DIPA Opening Remarks	IS Opening Remarks	META Opening Remarks	ORS Opening Remarks	
8:00 a.m.– 10:00 a.m.		DMA • Image Quality	IMA • Military Applications I	MMA • Metamaterials I	OMA • New Sensors and Methods I: Hyperspectral Imaging	
10:00 a.m.– 10:30 a.m.	Coffee Break/Exhibits Open, Pavilion					
10:30 a.m.– 12:30 p.m.	AMA • Optical Metrology I	DMB • Nonlinear Image Processing	IMB • Military Applications II	MMB • Plasmonics I	OMB • New Sensors and Methods II	
12:30 p.m.– 2:00 p.m.	Lunch Break (on your own)					
2:00 p.m.– 4:00 p.m.	AMB • Optical Metrology II (ends at 3:40 p.m.)	DMC • Image Restoration	IMC • Imaging Optics I	MMC • Towards Applications I	OMC • Developments in LiDAR	SMA • Keynote Session
4:00 p.m.– 4:30 p.m.	Coffee Break/Exhibits Open, Pavilion					
4:30 p.m.– 6:30 p.m.	AMC • Selected Topics: Optical Applications in Industry	DMD • Digital Image Processing and Optics (ends at 6:50 p.m.)	IMD • Imaging Optics II	MMD • Plasmonics II	OMD • Littoral Applications of Remote Sensing	SMB • Concentrator PV Systems
7:00 p.m.– 8:30 p.m.	Welcome Reception, Arizona Deck and Foyer					

Key to Conference Abbreviations

AIO	Applied Industrial Optics: Spectroscopy, Imaging, and Metrology
DIPA	Digital Image Processing and Analysis
IS	Imaging Systems
META	Photonic Metamaterials and Plasmonics
ORS	Optical Remote Sensing of the Environment
SOLAR	Optics for Solar Energy

Agenda of Sessions — Tuesday, June 8

	Sonoran I	Murphey I & II	Sonoran II	Canyon I	Finger Rock	Canyon III
	AIO	DIPA	IS	META	ORS	SOLAR
7:30 a.m.– 5:30 p.m.	Registration Open, Lobby Foyer					
8:00 a.m.– 10:00 a.m.	ATuA • Spectroscopy, Color, & Imaging I	DTuA • Medical Image Processing I	ITuA • Imaging Sensors I	MTuA • Metamaterials II	OTuA • Remote Sensing of Vegetation	STuA • Solar Concentrator Characterization
10:00 a.m.– 10:30 a.m.	Coffee Break/Exhibits Open, Pavilion					
10:30 a.m.– 12:30 p.m.	ATuB • Spectroscopy, Color, & Imaging II	DTuB • Medical Image Processing II	ITuB • Imaging Sensors II	MTuB • Plasmonics III	OTuB • Environmental Applications	STuB • Concentrator Design and Holographic Concentrator Systems
12:30 p.m.– 2:00 p.m.	Lunch Break (on your own)					
2:00 p.m.– 4:00 p.m.	JTuA • Joint AIO/IS/META/ORS Poster Session, Pavilion					
2:00 p.m.– 4:00 p.m.	STuC • Coatings and Light Trapping, Canyon III					
4:00 p.m.– 4:30 p.m.	Coffee Break/Exhibits Open, Pavilion					
4:30 p.m.– 6:30 p.m.	ATuC • Chemical Sensing		ITuC • Imaging Sensors III	MTuC • Plasmonics IV		STuD • Concentrator System Design
7:00 p.m.– 7:45 p.m.	STuE • Solar Poster Session, Pavilion					
8:00 p.m.– 9:00 p.m.	AIO Rump Session					SOLAR Rump Session

Key to Conference Abbreviations

AIO	Applied Industrial Optics: Spectroscopy, Imaging, and Metrology
DIPA	Digital Image Processing and Analysis
IS	Imaging Systems
META	Photonic Metamaterials and Plasmonics
ORS	Optical Remote Sensing of the Environment
SOLAR	Optics for Solar Energy

Agenda of Sessions — Wednesday, June 9

	Sonoran I	Murphey I & II	Sonoran II	Canyon I	Finger Rock	Canyon III
	AIO	DIPA	IS	META	ORS	SOLAR
7:30 a.m.– 5:00 p.m.	Registration Open, Lobby Foyer					
8:00 a.m.– 10:00 a.m.			IWA • Computational Imaging I	MWA • Active Structures		SWA • Light Trapping and Plasmonics
10:00 a.m.– 10:30 a.m.	Coffee Break/Exhibits Open, Pavilion					
10:30 a.m.– 12:30 p.m.			IWB • Computational Imaging II (ends at 11:50 a.m.)	MWB • Metamaterials III		SWB • Light Management and Spectrum Splitting
12:30 p.m.– 2:00 p.m.	Lunch Break (on your own)					
2:00 p.m.– 4:00 p.m.			IWC • 3-D Imaging	MWC • Plasmonics V		SWC • Device and Module Characterization
4:00 p.m.– 4:30 p.m.	Coffee Break/Exhibits Open, Pavilion					
4:30 p.m.– 6:30 p.m.			IWD • Projective Imaging (ends at 6:10 p.m.)	MWD • Towards 3-D Structures		SWD • Organic and Thin Film PV

Key to Conference Abbreviations

AIO **Applied Industrial Optics: Spectroscopy, Imaging, and Metrology**

DIPA **Digital Image Processing and Analysis**

IS **Imaging Systems**

META **Photonic Metamaterials and Plasmonics**

ORS **Optical Remote Sensing of the Environment**

SOLAR **Optics for Solar Energy**

Murphey I & II

Digital Image Processing and Analysis

Sonoran II

Imaging Systems

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

8:00 a.m.–10:00 a.m.

DMA • Image Quality

David G. Stork; Ricoh Innovations, USA, Presider

DMA1 • 8:00 a.m. Plenary

Blind Image Quality Assessment is Not Impossible, *Alan C. Bovik; Univ. of Texas at Austin, USA*. In this talk I will discuss our recent efforts on blind or “no reference” image quality assessment problems, including machine learning approaches and the looming question of stereo (3-D) image quality.

DMA2 • 9:00 a.m. Invited

Application-Driven Spectral Image Quality Assessment and Prediction, *John P. Kerekes; Rochester Inst. of Technology, USA*. The assignment of a quantitative spectral image quality metric is discussed with an approach proposed. Quality is divided into fidelity and utility components, with utility studied in the context of object detection in hyperspectral imagery.

DMA3 • 9:40 a.m.

Image Interpolation Using FREBAS Transform with Single Image-Based Super-Resolution, *Satoshi Ito, Yushii Harada, Yoshifumi Yamada; Utsunomiya Univ., Japan*. Image interpolation with super-resolution effects using the FREBAS transform, which is a kind of multi-resolution analysis, is proposed. Real-value constraint in the iteratively algorithm extrapolate the signal in the FREBAS domain and images makes clear.

8:00 a.m.–10:00 a.m.

IMA • Military Applications I

Ronald Driggers; NRL, USA, Presider

IMA1 • 8:00 a.m. Invited

Military Imaging System Performance, *Keith Krapels; US Army Night Vision Lab, USA*. Abstract not available.

IMA2 • 8:40 a.m. Invited

Imaging Systems in the Army, *Don Reago; US Army Night Vision Lab, USA*. Abstract not available.

IMA3 • 9:20 a.m. Invited

Advanced Imaging Systems for Navy Applications, *James Waterman; NRL, USA*. Imaging system capability in the infrared has been advanced significantly over the past 5 years due to innovations in detector, readout circuit, electronics, optics, and image processing technology.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits Open, Pavilion

Canyon I

Photonic Metamaterials
and Plasmonics

Finger Rock

Optical Remote Sensing of
the Environment

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

8:00 a.m.–10:00 a.m.

MMA • Metamaterials I

Martin Wegener; Karlsruhe Inst. of Technology, Univ. of Karlsruhe, Germany, Presider

MMA1 • 8:00 a.m. Invited

Controlling Light at the Nanoscale: Nonlinear and Switchable Photonic Metamaterials, *Nikolay Zheludev; Univ. of Southampton, UK*. Composite metamaterials containing chalcogenide glass, carbon nanotubes, graphene, semiconductor quantum dots and fabricated from cuprate superconductor offer new photonic functionalities.

MMA2 • 8:40 a.m. Invited

High Harmonic Generation in Plasmonic Nanostructure, *Seung-Woo Kim, In-Yong Park, Seungchul Kim, Joonhee Choi; KAIST, Republic of Korea*. 2-D and 3-D metallic nanostructures are fabricated and tested to generate EUV high harmonics by enhancing the electric field of a femtosecond laser by means of surface plasmons resonance.

MMA3 • 9:20 a.m.

Two-Photon Absorption Enhancement with Gold Nanoantennas Array, *Joshua D. Borneman¹, Vladimir P. Drachev¹, Kuo-Ping Chen¹, Alexander V. Kildishev¹, Vladimir M. Shalaev¹, Konstantin Yamnitskiy², Robert Norwood², N. Peyghambarian², Lazaro A. Padilha², Scott Webster², David J. Hagan³, Eric W. Van Stryland³; ¹Purdue Univ., USA, ²Univ. of Arizona, USA, ³Univ. of Central Florida, USA*. Gold dipole nanoantennas which have strong local electromagnetic fields are used to enhance two-photon absorption. A 30 to 40 times enhancement is observed for BDPAS (4,4'-bis(diphenylamino) stilbene) at 600 nm.

MMA4 • 9:40 a.m.

Flipped-Fishnet Structure Design for Optical Modulator, *Jun Xu, Hyungjin Ma, Nicholas X. Fang; Univ. of Illinois at Urbana-Champaign, USA*. We investigate a novel design of NIM modulator for optical communication. Numerical studies indicate a strong modulation of fiber-guided signal. Experimental observation verifies simulation results, that shows the good potential for on-fiber small footprint modulator.

8:00 a.m.–10:00 a.m.

OMA • New Sensors and Methods I: Hyperspectral Imaging

Melba Crawford; Purdue Univ., USA, Presider

OMA1 • 8:00 a.m.

A Comparison of Optical Design Forms of Hyperspectral Instruments for Remote Sensing, *Timothy N. Miller, Raymond M. Bell, Jr.; Lockheed Martin Space Systems Co., USA*. We describe and compare five popular optical designs for remote-sensing hyperspectral sensors. We discuss the benefits and limitations of each, and consider first-order parameters that may lead a designer towards a particular option.

OMA2 • 8:20 a.m. Invited

Detailed Terrain Characterization from a Space Based Imaging Spectrometer, *Thomas W. Cooley; AFRL, USA*. Imaging spectrometers have been developed and matured over the past 30 years beginning with developmental airborne systems. Beginning with the NASA Hyperion instrument, space borne systems are providing data to a broad user community to explore the myriad applications of spaceborne imaging spectrometer data. This presentation will explore the range of terrain characterization applications and products which are being addressed currently and those that could be met in the future as sensors are improved and tailored to the user needs.

OMA3 • 9:00 a.m.

Atmospheric Correction of Spectral Imagery from Sensor Systems with Changing Viewing Geometry over a Scene, *Gerald W. Felde, Gail P. Anderson, Thomas W. Cooley; AFRL, USA*. Simulated radiance cubes are used to gain a quantitative understanding of FLAASH reflectance retrieval errors due to viewing geometry errors. For a particular zenith view angle error, the retrieval error increases as the viewing becomes more off-nadir.

OMA4 • 9:20 a.m. Invited

The Hyperspectral Imager for the Coastal Ocean (HICO) and Environmental Characterization of the Coastal Zone from the International Space Station, *Michael Corson¹, Robert L. Lucke¹, Curtiss O. Davis²; ¹NRL, USA, ²Oregon State Univ., USA*. The Hyperspectral Imager for the Coastal Ocean (HICO) operating on the International Space Station is the first demonstration of environmental characterization of the coastal ocean using hyperspectral imagery from space.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits Open, Pavilion

Sonoran I

Applied Industrial Optics: Spectroscopy, Imaging, and Metrology

Murphey I & II

Digital Image Processing and Analysis

Sonoran II

Imaging Systems

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30 a.m.–12:30 p.m.
AMA • Optical Metrology I

Jess Ford; Weatherford Intl., USA, *Presider*

AMA1 • 10:30 a.m. **Invited**

Title to Be Announced, *Edgar A. Mendoza; Redondo Optics Inc., USA. Abstract not available.*

AMA2 • 11:10 a.m.

Fluorescence Lifetime Sensing of Temperature with Erbium Doped Lead Germano Tellurite Glass, *Indumathi Kamma, Rami Reddy Bommarreddi; Alabama A&M Univ., USA. A non contact and nondestructive method is described for optical sensing of temperature by measuring laser excited fluorescence from erbium doped glass. Temperature calibration plot has been developed from room temperature to 600C.*

AMA3 • 11:30 a.m.

Extremely High-Resolution LADAR System for Precision Length Metrology and Imaging, *Peter A. Roos¹, Randy R. Reibel¹, Trenton J. Berg¹, Brant M. Kaylor¹, Zeb W. Barber², Wm. Randall Babbitt²; ¹Bridger Photonics, Inc., USA, ²Spectrum Lab, Montana State Univ., USA. We report a precision LADAR system that can achieve 35 μ m FWHM range-peak-width resolution and 86 nm range precisions for absolute distance and length metrology and precision 3-D LADAR imaging applications.*

AMA4 • 11:50 a.m. **Invited**

Title to Be Announced, *Carl Jackson; Sensl, Ireland. Abstract not available.*

10:30 a.m.–12:30 p.m.

DMB • Nonlinear Image Processing

Michael T. Orchard; Rice Univ., USA, *Presider*

DMB1 • 10:30 a.m. **Invited**

Nonlinear Image Representation: Lessons from Biology, *Eero Simoncelli; New York Univ., USA. Abstract not available.*

DMB2 • 11:10 a.m. **Invited**

Sparse Reconstructions Using Simple Transforms: Tessellating the State-of-the-Art in Image Reconstruction, *Onur Guleryuz; DCOMO Communications Labs USA, Inc., USA. Abstract not available.*

DMB3 • 11:50 a.m.

Dictionary-Based Optical Filter Selection for Multi-Application Spectral Signature Classification, *Jun Ke¹, Kathrin Berkner², Dirk Robinson², David G. Stork²; ¹Univ. of Arizona, USA, ²Ricoh Innovations, Inc., USA. We describe a method for selecting filter sets for simultaneously optimizing the classification rates in two separate spectral signature classification problems. Our system's performance is comparable to traditional hyper- or multispectral classifiers, but uses fewer filters.*

DMB4 • 12:10 p.m.

Continuum Fusion: A New Beginning for Non-Bayesian Detection Algorithms, *Alan Schaum; NRL, USA. A new methodology is described for addressing composite hypothesis testing problems. Continuum Fusion integrates an infinity of optimal methods, when the correct choice is unknown. An example problem is solved geometrically.*

10:30 a.m.–12:30 p.m.

IMB • Military Applications II

Don Reago; US Army Night Vision Lab, USA, *Presider*

IMB1 • 10:30 a.m. **Invited**

Imaging at DARPA MTO, *Nibir Dhar; DARPA, USA. Abstract not available.*

IMB2 • 11:10 a.m.

Static Architecture for Compressive Motion Detection in Persistent, Pervasive Surveillance Applications, *Michael D. Stenner¹, Daniel J. Townsend¹, Michael E. Gehm²; ¹MITRE Corp., USA, ²Univ. of Arizona, USA. High-resolution, wide-field-of-view airborne imaging produces large optical systems and data streams. Significant simplification is possible if motion detection, rather than full imaging, is the goal. We consider a static, compressive-sensing architecture for this problem.*

IMB3 • 11:30 a.m.

Performance Testing of an Extended Depth of Field Digital Night Vision Device, *Jonathan C. James¹, R. Brandon Vaughan¹, Jack W. Wood¹, Gisele Bennett¹, Russell S. Draper², Art Hastings², James Stevens², Kyle Bryant²; ¹Georgia Tech Res. Inst., USA, ²Night Vision and Electronic Sensors Directorate, US Army Res., Development and Engineering Command, USA. Performance testing of a night vision technology demonstrator incorporating wavefront coding to increase image depth-of-field was recently completed. Test results indicate that depth-of-field was increased with some loss in performance in other image quality aspects.*

IMB4 • 11:50 a.m.

New Technologies to Enable Millimeter-Wave Imaging, *Joseph N. Mait¹, David A. Wikner¹, Mark S. Mirotznik², Christy Fernandez-Cull³; ¹ARL, USA, ²Univ. of Delaware, USA, ³Duke Univ., USA. We apply structured passive elements and computational imaging to millimeter waves to enable a mobile imager. Experimental results are presented.*

IMB5 • 12:10 p.m.

Rugged Optics for Multispectral Imaging Systems, *Ishwar Aggarwal, Jasbinder Sanghera, Shyam Bayya, Woohong Kim, Andrew Miller, Brandon Shaw, Erin Fleet; NRL, USA. We have developed a new rugged multiband optic with transmission in SWIR, MWIR and LWIR region from a new polycrystalline ceramic material. The status of these development efforts will be discussed.*

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

Canyon I

Photonic Metamaterials
and Plasmonics

Finger Rock

Optical Remote Sensing of
the Environment

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30 a.m.–12:30 p.m.

MMB • Plasmonics I

Mark I. Stockman; Georgia State Univ., USA, Presider

MMB1 • 10:30 a.m. Invited

Surface Enhanced Raman Scattering Using the “Hottest” Hot Spots Only, *Katrin Kneipp, Harald Kneipp; Technical Univ. of Denmark, Denmark*. We report SERS of single molecules residing exclusively in the hottest hot spots of silver or gold nanoaggregates or on a fractal surface of those metals and discuss the ultimate spectroscopic potential of such experiments.

MMB2 • 11:10 a.m. Invited

Molecular Plasmonics: Single Molecules and Single Nanoparticles, *Richard Van Duyn; Northwestern Univ., USA*. Abstract not available.

MMB3 • 11:50 a.m.

Large-Area Dense Plasmonic Nanoarrays for Surface Enhanced Raman Applications, *Vladimir Liberman¹, Cihan Yilmaz², Theodore M. Bloomstein¹, Mordechai Rothschild¹, Sivasubramanian Somu², Yolanda Echegoyen², Ahmed Busnaina²; ¹MIT Lincoln Lab, USA, ²NSF Nanoscale Science and Engineering Ctr. for High-Rate Nanomanufacturing, USA*. Two new techniques for forming dense plasmonic nanoarrays utilizing 157-nm interference lithography on a 90-nm pitch grid include 1) convective assembly of Au nanoparticles into pre-patterned PMMA templates and 2) direct patterning of Ag nanocones.

MMB4 • 12:10 p.m.

Experimental Demonstration of a Plasmonic Sensor Based on Perfect Absorption, *Na Liu^{1,2}, Martin Mesch², Thomas Weiss², Harald Giessen²; ¹Lawrence Berkeley Natl. Lab, Univ. of California at Berkeley, USA, ²Univ. of Stuttgart, Germany*. We demonstrate a near-infrared narrow-band plasmonic perfect absorber. Our sensor is wide angle, nearly polarization independent, and allows for the extremely sensitive detection of concentration changes of glucose solution at a fixed frequency.

10:30 a.m.–12:30 p.m.

OMB • New Sensors and Methods II

John Cipar; AFRL, USA, Presider

OMB1 • 10:30 a.m. Invited

Coastal Features and River Plumes as Seen with the Hyperspectral Imager for the Coastal Ocean (HICO), *Curt O. Davis¹, Robert Arnone², Richard Gould², Michael R. Corson², Marcos Montes³; ¹Oregon State Univ., USA, ²Stennis Space Ctr., NRL, USA, ³NRL, USA*. The Hyperspectral Imager for the Coastal Ocean (HICO) is now operating on the International Space Station. Here we review the processing of HICO data and its application to study coastal features and river plumes.

OMB2 • 11:10 a.m.

Snapshot Spectral Imaging Using Birefringent Interferometry and Image Replication, *Alistair Gorman, Gonzalo Muyo, Andrew R. Harvey; Heriot-Watt Univ., UK*. A snapshot multi-spectral imaging technique is described which employs cascaded birefringent interferometers to simultaneously project multiple spectral images onto a single detector array. Example images are also shown.

OMB3 • 11:30 a.m.

Flight Model Development of a Compact Imaging Spectrometer for a Microsatellite STSAT3, *Jun Ho Lee¹, Tae Seong Jang², Kyung In Kang², Seung-Wu Rhee³; ¹Kongju Natl. Univ., Republic of Korea, ²KAIST, Republic of Korea, ³Korea Aerospace Res. Inst., Republic of Korea*. COMIS is a very compact imaging spectrometer for STSAT3. It weighs only 4.3kg while being capable of hyperspectral imaging at GSDs of 27 m over a 28 km swath at an altitude of 700 km.

OMB4 • 11:50 a.m. Invited

Bringing All Lidar Data Together: Investigations of Spatially Coincident Terrestrial, Airborne, and Satellite Lidar Data for Deriving Vegetation Structure Metrics, *Sorin Popescu; Texas A&M Univ., USA*. This study aims to compare forest structure metrics obtained by processing data from spatially coincident discrete-return airborne lidar, ICESat waveforms, and a ground-based laser scanner. Results are significant for scaling up and calibration purposes.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

Sonoran I

Applied Industrial Optics: Spectroscopy, Imaging, and Metrology

Murphey I & II

Digital Image Processing and Analysis

Sonoran II

Imaging Systems

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

2:00 p.m.–3:20 p.m.**AMB • Optical Metrology II**

Dominick Polizzi; Optics Technology Inc., USA, Presider

AMB1 • 2:00 p.m.

Optical Diffraction Based Single Image Method to Obtain Nanometer Resolution Deflection Profiles in Micro-Cantilever Based Sensors, Arindam Phani; Indian Inst. of Science, India. A single image Optical Diffraction based profiling method is proposed employing a double micro-cantilever(MC) structure achieving deflection resolutions of 1nm and surface stress changes of 50 μ N/m in a typical MC based sensor.

AMB2 • 2:20 p.m.

Flexible and Convertible Depth Exposure in Fluorescence Microscopy, Koichiro Kishima; Sony Corp., Japan. We proposed and confirmed the effective method to measure three dimensional positions of fluorescent markers by only a couple of exposure with conventional fluorescence microscope. We also demonstrated this method for measuring chromatic aberration.

AMB3 • 2:40 p.m. Invited

A Case Study in Measuring Ultra-Low Level Sulfur in Diesel Using WD-XRF, Larry Arias, Alexander Seyfarth; Bruker AXS Inc., USA. The talk illustrates the progression of X-Ray Fluorescence spectroscopy (XRF) Wavelength dispersive instrumentation as a function of the measurement of sulfur in diesel based on the ASTM D-2622 method.

2:00 p.m.–4:00 p.m.**DMC • Image Restoration**

Eero Simoncelli; New York Univ., USA, Presider

DMC1 • 2:00 p.m. Invited

Image Priors and Blind Deconvolution, William Freeman; MIT, USA. "Blind deconvolution" is a beautiful, ill-posed problem: given an image that has been blurred by some unknown convolution kernel, estimate the image before it was blurred. Lurking within this problem are nice, deep questions: What is an image, and how can you tell when one has been blurred? How should we solve very underdetermined inference problems?

DMC2 • 2:40 p.m.

Object Dependent Manifold Priors for Image Deconvolution, Jie Ni, Pavan Turaga, Vishal M. Patel, Rama Chellappa; Dept. of Electrical and Computer Engineering, Univ. of Maryland, USA. In this paper we propose a manifold based deconvolution algorithm by estimating a manifold from a set of natural images that exploits the availability of the sample class data for regularizing the deblurring problem.

DMC3 • 3:00 p.m.

Wide Angle Ir Detection through a Conical Mirror: Some Preliminary Results, Thomas B. Slack, Robert K. Reynolds, Khan Iftikharuddin; Univ. of Memphis, USA. 360° planar viewing is achieved by placing a polished aluminum cone in front of a long-wave IR camera. Objects are extracted from the circular reflected image for means of detection and classification.

DMC4 • 3:20 p.m.

Iterative Exposure Bracketing, Keigo Hirakawa; Univ. of Dayton, USA. High dynamic range (HDR) imaging requires bracketing—low dynamic range images with varying exposures—and postprocessing to blend appropriately exposed portions together. We analyze HDR recoverability of bracketing, which is not well understood despite popularity of HDR.

DMC5 • 3:40 p.m.

Discrete Filters and Transforms to Localize Signal Transitions, Ramakrishnan Sundaram; Gannon Univ., USA. Band-pass filters and block-based transforms are developed to retrieve signal discontinuities in sampled data. The filter coefficients are determined from the space or frequency-sampled Laplacian-of-Gaussian filter. The procedure is applied to detect edges in images.

2:00 p.m.–4:00 p.m.**IMC • Imaging Optics I**

Gisele Bennett; Georgia Tech, USA, Presider

IMC1 • 2:00 p.m. Invited

An Aberration-Free Lens with Zero F-Number, David Schurig; North Carolina State Univ., USA. Starting from the Luneberg lens index profile, we apply the transformation design method to the problem of far-field imaging of (infinitely) distant objects.

IMC2 • 2:40 p.m. Invited

Extreme Form Factor Imagers, Joseph E. Ford, Eric Tremblay; Univ. of California at San Diego, USA. Optical design for imagers is always a problem in constrained optimization, where the application provides both optical performance as well as the typically conflicting constraints on the system cost and/or physical footprint. Here we review work on several imaging systems where the physical shape of the imager has been a dominant factor in the optical system design, including a narrow imager and light source in a laryngoscope for neonatal infants as well as a number of extremely thin imagers based on the concentric folded lens geometry.

IMC3 • 3:20 p.m.

Lens Aberration Correction Using Locally Optimal Mask Based Low Cost Light Field Cameras, Rohit Pandharkar, Ahmed Kirmani, Ramesh Raskar; MIT, USA. We present a method to convert the ill-posed deblurring problem into a well-posed one allowing efficient deblurring of the lens aberration blur. We achieve this by building a locally optimal mask low cost lightfield camera.

IMC4 • 3:40 p.m.

Increased Field of View through Optical Multiplexing, Vicha Treeaporn, Amit Ashok, Mark A. Neifeld; Univ. of Arizona, USA. A compact thin-film shuttered multi-beamsplitter superposition imaging solution to reduce some of the system size and weight costs typically associated with conventional wide field of view imaging techniques is described and demonstrated.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits Open, Pavilion

Canyon IPhotonic Metamaterials
and Plasmonics**Finger Rock**Optical Remote Sensing of
the Environment**Canyon III**

Optics for Solar Energy

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.**2:00 p.m.–4:00 p.m.****MMC • Toward Applications I***Katrin Kneipp; Technical Univ. of Denmark, Denmark, Presider***MMC1 • 2:00 p.m.**

An Integrated Electrically Driven Coherent Source of Surface Plasmon Polaritons, *Chulsoo Kim, Igor Vurgaftman, Richard A. Flynn, J. R. Lindle, William W. Bewley, Konrad Bussmann, Jerry R. Meyer, James P. Long; NRL, USA*. We demonstrate a versatile electrically-driven source of coherent SPPs by end-coupling a quantum-well laser to an integrated plasmonic waveguide with coupling efficiency of $\approx 36\%$. The SPP peak power generated at room temperature is 36 mW.

MMC2 • 2:20 p.m.

Electromodulation of Photonic Metamaterials, *Lihua Shao¹, Matthias Ruthler¹, Stefan Linden¹, Joerg Weissmueller¹, Martin Wegener²; ¹Inst. of Nanotechnology, Karlsruhe Inst. of Technology, Germany, ²Inst. of Applied Physics, Karlsruhe Inst. of Technology, Germany*. By applying voltages of about 1V to very thin metal nanostructures via an aqueous electrolyte, we demonstrate reversible modulation of split-ring-resonator resonances by as much as 60 THz at around 300 THz resonance frequency.

MMC3 • 2:40 p.m.

Paper Withdrawn

MMC4 • 3:00 p.m.

A Novel Approach of Antireflection Coating Using Planar Metamaterials, *Hou-Tong Chen, Jiangfeng Zhou, John F. O'Hara, Frank F. Chen, Abul K. Azad, Antoinette J. Taylor; Los Alamos Natl. Lab, USA*. We experimentally demonstrate a novel antireflection coating using planar metamaterials. It dramatically reduces the reflectance and enhances the transmittance over a wide range of incidence angles for both polarizations near the designed wavelengths.

MMC5 • 3:20 p.m. Invited

Fast and Low Power Optical Modulation in Metamaterials *Nicholas Fang; Univ. of Illinois at Urbana-Champaign, USA*. In this talk, I will discuss the progress of optical modulation in fishnet metamaterials at telecommunication wavelength. To optimize the modulation depth, we conducted analysis using an effective LC circuit model.

2:00 p.m.–4:00 p.m.**OMC • Developments in LiDAR***Chris Parrish; NOAA/NOS, Natl. Geodetic Survey, USA, Presider***OMC1 • 2:00 p.m.**

Using Lidar Surface Returns to Reduce Uncertainty in Aerosol Retrievals from Elastic Scatter Lidar, *John Reagan, Christopher McPherson; Univ. of Arizona, USA*. This paper addresses methods for improving atmospheric aerosol retrievals from elastic scatter lidar by taking into account surface returns from land and water as a constraint on the retrieval.

OMC2 • 2:20 p.m.

Mapping Land Use Patterns in an Urbanizing Landscape Using LiDAR Intensity Data, *Kunwar K. Singh, John B. Vogler, Qingmin Meng, Ross K. Meentemeyer; Univ. of North Carolina at Charlotte, USA*. This paper demonstrates that LiDAR intensity can be a feasible alternative for accurate mapping and assessment of land use patterns in an urbanized landscape at high accuracy by integrating intensity with other derivatives of LiDAR.

OMC3 • 2:40 p.m.

Mid-Infrared Laser Source For Long-Range Range-Resolved Remote Monitoring of CO₂, *Trenton J. Berg, Peter A. Roos; Bridger Photonics, Inc., USA*. We report a sub-10-ns, > 1 mJ mid-infrared laser at 2.0 μ m for remote sensing and range resolved concentration mappings of carbon dioxide. The source will enable meter-level CO₂ measurements from 100-meter distances.

OMC4 • 3:00 p.m. Invited

Simulating an Airborne Lidar Bathymetry (ALB) System, *Shachak Pe'eri, Amaresh M. V. Kumar, Brian R. Calder; Univ. of New Hampshire, USA*. This study's focus is on the horizontal and vertical uncertainties associated with ALB measurements due to scattering through the water column. A lidar simulator was constructed and we present its design and preliminary results.

OMC5 • 3:40 p.m.

New Approaches for Evaluating Lidar-Derived Shoreline, *Christopher E. Parrish¹, Stephen A. White¹, Brian R. Calder², Shachak Pe'eri², Yuri Rzhano²; ¹NOAA/NOS, Natl. Geodetic Survey, USA, ²Ctr. for Coastal and Ocean Mapping, Univ. of New Hampshire, USA*. This study presents and compares two new methods of assessing the uncertainty of lidar-derived National Shoreline mapped by NOAA's National Geodetic Survey: an empirical (ground-based) approach and a stochastic (Monte Carlo) approach.

2:00 p.m.–4:00 p.m.**SMA • Keynote Session***Alan Kost; Univ. of Arizona, USA, Presider***SMA1 • 2:00 p.m. Invited**

Introducing the Department of Energy's Advanced Research Projects Agency – Energy (ARPA-E): Finding Solar Energy Technology Gamechangers in a Crowded Field, *David Danielson; Advanced Res. Projects Agency - Energy (ARPA-E), USA*. In this talk, ARPA-E's Founding Program Director Dr. David Danielson will provide an introduction to ARPA-E's approach to investing in transformational energy R&D projects and will discuss potential game-changing opportunities in solar energy technology.

SMA2 • 3:00 p.m. Invited

Maximizing the Efficiency Cost Ratio in a CPV System via a Tolerant Optical Design, *Juan C. Miñano^{1,2}, Pablo Benítez^{1,2}, Pablo Zamora², Rubén Moledano¹, Aleksandra Cvetkovic¹, Marina Buljan², Julio Chaves¹, Roberto Alvarez¹; ¹LPI, USA, ²Univ. Politécnic de Madrid, Spain*. An advanced CPV-concentrator with a Fresnel primary and a refractive secondary produces both high concentration with high tolerance and excellent light homogenization. It compares well with conventional Fresnel-based CPV from both optical and cost standpoints.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits Open, Pavilion

Sonoran I

Applied Industrial Optics: Spectroscopy, Imaging, and Metrology

Murphey I & II

Digital Image Processing and Analysis

Sonoran II

Imaging Systems

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4:30 p.m.–6:30 p.m.

AMC • Selected Topics: Optical Applications in Industry

Sean M. Christian; Optrology, Inc., USA, President

AMC1 • 4:30 p.m. **Invited**

LIBS in Industry: Sparks Fly, Steven G. Buckley¹, Gregg A. Lithgow¹, Christopher B. Stipe²; ¹Photon Machines, Inc., USA, ²Seattle Univ., USA. Laser-induced breakdown spectroscopy (LIBS) is emerging as a potent industrial spectroscopy. Uniquely capable for light-element detection, useful for material identification, depth profiling, and elemental surface mapping, LIBS can solve numerous industrial problems in real-time.

AMC2 • 5:10 p.m.

Design and Development of Micro Inspection Device for Product Packages, James Joseph, Vinay Ravi, Lye Sun Woh, Murukeshan Vadakke Matham; Nanyang Technological Univ., Singapore. Defect detection in product packages is essential for safe storage and transportation of manufactured products. A micro imaging device used to perform product package inspection and the methods to accomplish the defect detection is presented.

AMC3 • 5:30 p.m.

Rapid Screening for Quality Control and Adulteration in Anti-Diabetic Drugs: Quantitative and Qualitative Analysis by LIBS, Ulises Contreras¹, Nancy Ornelas-Soto¹, Marco A. Meneses-Nava¹, Oracio Barbosa-García¹, Pedro L. López-de-Alba², Leticia López-Martínez³; ¹Cent. de Investigaciones en Óptica, A.P., Mexico, ²Inst. de Investigaciones Científicas, Univ. de Guanajuato, Mexico. This work describes an anti-diabetic medicament analysis by using LIBS. The emissions from elements present only in the active pharmaceutical ingredient and the Intensity ratios between them and the sample's background allow a quality inspection.

AMC4 • 5:50 p.m. **Invited**

Deploying LIBS in Industry: Four Examples of Applied LIBS Technologies, Arel Weisberg¹, Joseph Craparo¹, Robert De Saro¹, Carlos Romero², Romauld Pawluczyk³, Andrew I. Whitehouse⁴; ¹Energy Res. Co., USA, ²Energy Res. Ctr., Lehigh Univ., USA, ³P&P Optica, Canada, ⁴Applied Photonics, Ltd., UK. Energy Research Company and its partners have developed LIBS for aluminum manufacturing, coal-fired power production, and other industrial applications. In this paper we review essential design aspects of the equipment and their resulting performance advantages.

4:30 p.m.–6:50 p.m.

DMD • Digital Image Processing and Optics

William Pratt; Univ. of Southern California, USA, President

DMD1 • 4:30 p.m.

Image-Based Measurement of Phase Transfer Function, Vikram R. Bhakta, Manjunath Somayaji, Marc P. Christensen; Southern Methodist Univ., USA. A method for measuring the Phase Transfer Function (PTF) from a high-contrast edge image is proposed and the advantages of utilizing the knowledge of PTF in computational, sparse aperture and multiplexed imaging are discussed.

DMD2 • 4:50 p.m.

Synthetic Dual Wavelength Optical Phase Unwrapping Using Digital Image Processing, Alejandro Restrepo-Martínez¹, Román Castañeda²; ¹Inst. Tecnológico Metropolitano, Colombia, ²Univ. Nacional de Colombia Sede Medellín, Colombia. A Synthetic dual wavelength optical phase unwrapping (S-DWOPU) was developed. It had an optical and a synthetic phase map; last one, made by digital image processing. Then the dual wavelength optical phase unwrapping was done.

DMD3 • 5:10 p.m.

Adaptive Optics Photometry of Faint Companions with a Wavelet-Based Maximum Likelihood Estimator, Roberto Baena Gallé¹, Szymon Gladysz²; ¹Univ. of Barcelona, Spain, ²European Southern Observatory, Germany. We use the Bayesian framework and the wavelet transform to estimate differential photometry in binary systems imaged with adaptive optics. We compare our results to estimates obtained by using PSF-fitting and multi-frame blind deconvolution.

DMD4 • 5:30 p.m.

A Probabilistic Model for Stratospheric Soil-Independent Dust Aerosol Detection, Pablo Rivas-Perea, Jose G. Rosiles; Univ. of Texas at El Paso, USA. We present a simple probabilistic model for dust aerosol detection, analysing MODIS 11.3µm and 12.02µm thermal emissive bands. We introduce a dust aerosol probabilistic visualization, and a feasible extension to classification.

DMD5 • 5:50 p.m.

Neural Network for the Digital Cleaning of an Oil Painting, Cherry May Palomero, Maricor Soriano; Natl. Inst. of Physics, Philippines. We demonstrate that a neural network can be trained to learn the transformation from dirty to clean segments of a painting and used it to digitally clean an image of Amorsolo's "Malacañang by the River".

DMD6 • 6:10 p.m.

Multispectral Images Segmentation of Ancient Documents with Lattice Memories, Juan C. Valdiviezo-Navarro, Gonzalo Urcid-S.; Inst. Nacional de Astrofísica, Óptica y Electrónica, Mexico. This manuscript introduces a method for the autonomous segmentation of ancient documents multispectral images. The procedure uses lattice associative memories to determine the purest spectra in the scene. We present results from the Archimedes Palimpsest.

DMD7 • 6:30 p.m.

Characterization of Optical Images Using the Method of Phase Space Map, Manu Vaishakh¹, V. P. N. Nampoori²; ¹Nanyang Technological Univ., Singapore, ²Cochin Univ. of Science and Technology, India. We characterize optical images using reconstructed phase space which is employed in nonlinear dynamics using time series approach. Geometry of phase space is reconstructed with spatial variable taking the status of time variable.

4:30 p.m.–6:30 p.m.

IMD • Imaging Optics II

Peter Catrysse; Stanford Univ., USA, President

IMD1 • 4:30 p.m. **Invited**

The Issues of Artefacts and Noise in Hybrid Imaging Systems, Andrew Harvey¹, Mads Demenikov¹, Gonzalo D. Muyo¹, Tom Vetterburg¹, Nick Bustin², Ian Hasler², Andy Wood²; ¹Heriot-Watt Univ., UK, ²Qioptiq Ltd., UK. Previous research in hybrid imaging tends to have emphasized constancy of the modulation transfer function and ignored the significant variations in the phase-transfer function.

IMD2 • 5:10 p.m. **Invited**

Coherent Lensless Imaging, James R. Fienup; Inst. of Optics, Univ. of Rochester, USA. Coherent imaging has numerous advantages over incoherent imaging, but at a cost of requiring coherent laser illumination.

IMD3 • 5:50 p.m.

Creating Aperture Masks in Phase Space, Roarke W. Horstmeyer¹, Se Baek Oh²; ¹MIT Media Lab, USA, ²Dept. of Mechanical Engineering, MIT, USA. The Wigner distribution is used to model the PSF of an aperture mask at different defocus planes. Algorithmic methods of determining an optimal mask pattern for a desired set of impulse responses are investigated.

IMD4 • 6:10 p.m.

Optimization of Hybrid Imaging Systems Including Digital Deconvolution in the Presence of Noise, Frédéric Diaz^{1,2}, François Goudail², Brigitte Loiseaux¹, Jean-Pierre Huignard¹; ¹Thales Res. and Technology, France, ²Lab Charles Fabry de l'Institut d'Optique, CNRS, Univ. Paris-Sud, France. We address the depth of focus enhancement in hybrid imaging systems, including a phase mask and a deconvolution filter. A final image quality criterion is introduced to optimize and compare different masks.

7:00 p.m.–8:30 p.m. Welcome Reception, Arizona Deck and Foyer

Canyon I

Photonic Metamaterials
and Plasmonics

4:30 p.m.–6:30 p.m.

MMD • Plasmonics II

Nikolay Zheludev; Univ. of Southampton, UK, Presider

MMD1 • 4:30 p.m.

Measurement of the Coupling Efficiency for Surface Plasmon Modes Generated by Nanogrooves, *Qiaoqiang Gan¹, Yongkang Gao¹, Lin Zhu², Filbert Bartoli³; ¹Lehigh Univ., USA, ²Clemson Univ., USA.* We present a simple far-field experiment to validate the theoretical predicted functional dependence of the SPP coupling efficiency on groove width, in good agreement with the SPP picture proposed by Lalanne's group.

MMD2 • 4:50 p.m.

Theoretical Investigation of Fabrication-Related Disorders on the Properties of Subwavelength Metal-Dielectric-Metal Plasmonic Waveguides, *Changjun Min, Georgios Veronis; Louisiana State Univ., USA.* We rigorously investigate the effect of fabrication-related disorders in subwavelength metal-dielectric-metal plasmonic waveguides. We use a Monte Carlo method to calculate the roughness-induced enhancement of the attenuation coefficient with respect to a smooth waveguide.

MMD3 • 5:10 p.m. **Invited**

Plasmonic Resonators Based on Two-Wire Transmission Lines, *Bert Hecht; Univ. Würzburg, Germany.* Dark-mode resonators based on single-crystalline gold will be discussed that exhibit very small modal volumes and comparatively large Q-factors. Individual structures are analyzed by electron microscopy as well as 1- and 2-photon photoluminescence spectroscopy.

MMD4 • 5:50 p.m.

Optical Design with Inhomogeneous Resonant Guided Wave Networks, *Eyal Feigenbaum, Harry A. Atwater; Caltech, USA.* Resonant guided wave networks enable the design of enhanced Q-factor resonators; optical materials with network architecture-dependent wave dispersion; and a two color router.

MMD5 • 6:10 p.m.

Theory of Spoof Plasmons in Real Metals, *Anastasia Rusina, Maxim Durach, Mark I. Stockman; Georgia State Univ., USA.* We develop a theory of spoof plasmons propagating on real metals perforated with planar periodic grooves. The optimum geometrical parameters for the propagation and THz energy concentration are found.

Finger Rock

Optical Remote Sensing of
the Environment

4:30 p.m.–5:50 p.m.

OMD • Littoral Applications of Remote Sensing

Charles M. Bachmann; NRL, USA, Presider

OMD1 • 4:30 p.m.

Atmospheric Correction of Hyperspectral Imagery in the Littoral Environment, *Marcos J. Montes; NRL, USA.* Atmospheric correction of remote sensing imagery of littoral areas is challenging for numerous reasons. This presentation will include a review of these challenges, as well as a review of several proposed solutions.

OMD2 • 4:50 p.m.

Coastal Characterization from Hyperspectral Imagery, *Charles M. Bachmann¹, C. Reid Nichols², Marcos J. Montes¹, Robert A. Fusina³, John C. Fry², Rong-Rong Li², Deric Gray⁴, Daniel Korwan⁵, Christopher Parrish³, Jon Sellars³, Stephen A. White³, Jason Woolard³, Krista Lee⁴, Cecilia McConnon⁴, Jon Wende⁴; ¹NRL, USA, ²Marine Information Resource Corp., USA, ³NOAA/NOS, USA, ⁴Naval Postgraduate School, USA.* Coastal mapping products and models from hyperspectral remote sensing experiments in different coastal types are compared: barrier island coast (Virginia, 2007), coral coast (Hawaii 2009), mangrove coast (Australia, 2009), and coral limestone and volcanic coasts (Guam and CNMI, 2010).

OMD3 • 5:10 p.m.

Hyperspectral Remote Sensing for Mapping Littoral Water Depth, *Enjie Jing, Roy Hughes; Defence Science and Technology Organisation, Australia.* Bathymetry of littoral waters was retrieved from airborne hyperspectral sensor data. The result demonstrated that water depths up to 20 m can be extracted reasonably well compared with those from the conventional hydrographical survey means.

OMD4 • 5:30 p.m.

Comparison of Efficiency of Algorithms for Polarization Computation in Turbid Media, *Sergey V. Korkin¹, Vladimir P. Budak², Alexei I. Lyapustin¹; ¹Goddard Earth Sciences and Technology, Univ. of Maryland, USA, ²Moscow Power Engineering Inst., Russian Federation.* Fast yet accurate algorithm for polarization computation in a highly anisotropic scattering media is offered. The comparison with the traditional approach is produced.

Canyon III

Optics for Solar Energy

4:30 p.m.–6:30 p.m.

SMB • Concentrator PV Systems

Raymond Kostuk; Univ. of Arizona, USA, Presider

SMB1 • 4:30 p.m. **Invited**

Flatcon® Concentrator Photovoltaic Modules—Design Principles and Field Experience, *Andreas Gombert; Concentrix Solar GmbH, Germany.* The FLATCON® concentrator photovoltaic (CPV) technology is presented. The first system in the US was installed in 2009 and shows an AC power efficiency of 25% and an AC energy efficiency of 22%.

SMB2 • 5:10 p.m.

Non-Imagine Solar Stationary Concentrators with Using Combination of Prisms and Reflective Surfaces, *Sergey N. Kivalov, Richard Perez; ASRC, Univ. of Albany, USA.* The paper presents two designs of combined prismatic-parabola-cylindrical stationary concentrators. They reach 8.4X and 10.4X concentration levels for nonsymmetrical and symmetrical concentrators correspondingly and can be used with solar cells for electricity and heat generation.

SMB3 • 5:30 p.m.

Photovoltaic and Solar Thermal Improvement Factors in Fiber Optic Filtered Hybrid Systems, *Scott Shepard; College of Engineering and Computer Science, Univ. of Central Florida, USA.* We define photovoltaic and hybrid system improvement factors which can characterize the utility of optical filters for solar energy applications. Comparison of two types of optical fiber filtered concentrators is then facilitated by this metric.

SMB4 • 5:50 p.m. **Invited**

A 5KW CPV Collector Design Using an Inflated Plastic Film Primary Mirror, *Leo Baldwin; Cool Earth Solar, USA.* The design objectives and methodologies for a monolithic multichannel secondary optic to compliment the inflated plastic primary collector in a utility-scale concentrated photovoltaic system is presented.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

8:00 a.m.–10:00 a.m.

ATuA • Spectroscopy, Color, & Imaging I

Sean M. Christian; Optrology, Inc., USA, President

ATuA1 • 8:00 a.m. Invited

Long-Term Metrological Qualification of Optical Feedback Cavity Enhanced Absorption Spectroscopy (OFCEAS); Measurement of Dihydrogen Sulfur in Natural Gas, *Lucien Lonigro; ap2e, France*. Abstract not available.

ATuA2 • 8:40 a.m.

Point of Dispense Drug Verification Using Coded Aperture Raman Spectroscopy and Image Analysis, *David J. Brady, Prasant Potluri, Brett Guenther, Evan Cull, Yuting Qi, Ken Chapman; Centice Corp., USA*. Coded aperture Raman spectroscopy enables standoff through container classification of wide classes of dispensed pharmaceuticals. Sensitivity relative to conventional Raman systems is increased by nearly an order of magnitude, enabling efficient integration in pharmacy workflow.

ATuA3 • 9:00 a.m.

Online NIR Multispectral Imaging Using Non-Contact Interactance for Fish and Meat Quality Measurements, *Marion O'Farrell¹, Jon Tschudi¹, Helene Schulerud¹, Jens Petter Wold², Silje Ottestad²; ¹Sintef ICT, Norway, ²Nofima Mat AS, Norway*. A NIR multispectral imaging system in the region 760-1040nm, that achieves non-contact interactance, is presented. The absorption of the light is increased and measurement of inhomogeneous or intact food products is possible.

ATuA4 • 9:20 a.m.

Dichroic Filter Array Multispectral Imaging Systems, *Jason M. Eichenholz; Ocean Optics Inc., USA*. The lithographically patterned dichroic filter arrays (DFAs) is a new approach to multispectral imaging. The DFA technique offers simultaneous spectral and spatial imaging at a significant cost, size, and complexity advantage over conventional hyperspectral imagers.

ATuA5 • 9:40 a.m.

AOTF Reflectance Spectroscopy: A Diagnostic of Organically Modified Surfaces, *Rula M. Tawalbeh, David Voelz, David Glenar, Xifeng Xiao, Nancy Chanover; New Mexico State Univ., USA*. A compact AOTF-based point spectrometer that operates at room temperature is described for measuring reflectance spectra over the 1.7 to 3.4 μm range. It provides "quick look" in situ detection of organically modified surfaces.

8:00 a.m.–9:40 a.m.

DTuA • Medical Image Processing I

Alan C. Bovik; Univ. of Texas at Austin, USA, President

DTuA1 • 8:00 a.m. Plenary

What Can Digital Processing Do for 3-D Super-Resolution Microscopy? *Rafael Piestun; Univ. of Colorado at Boulder, USA*. Novel three-dimensional fluorescence microscopy techniques enable diffraction unlimited imaging. Resolution is limited by the photon count and the underlying noise. I discuss the role digital design and post-processing plays in attaining the new fundamental limits.

DTuA2 • 9:00 a.m.

3-D Reconstruction of Fluorescence Microscopy Image Intensities Using Multiple Depth-Variant Point-Spread Functions, *Vimeetha Myneni, Chrysanthe Preza; Univ. of Memphis, USA*. We show that the use of multiple depth-variant point-spread functions in 3-D fluorescence intensity reconstruction provides improved optical sectioning over deconvolution methods by correcting depth-induced aberrations in 3-D cell images.

DTuA3 • 9:20 a.m.

Performance Tradeoffs in a Model Breast Tomosynthesis System, *Stefano Young¹, Predrag Bakic², Kyle J. Myers³, Subok Park³; ¹Univ. of Arizona, USA, ²Univ. of Pennsylvania, USA, ³FDA Ctr. for Devices and Radiological Health, USA*. Digital breast tomosynthesis (DBT) researchers need accurate, inexpensive, task-based assessment tools for optimizing multivariate DBT systems. With improved object statistics and better multiprojection observer models, our computational framework approaches detailed multi-parameter mapping of performance tradeoffs.

8:00 a.m.–10:00 a.m.

ITuA • Imaging Sensors I

Boyd Fowler; Fairchild Imaging, USA, President

ITuA1 • 8:00 a.m. Invited

Near-Field Imaging of Infrared Antennas, *Peter M. Krenz¹, Glenn D. Boreman¹, Brian A. Lail², Robert Olmon³, Markus Raschke³; ¹Univ. of Central Florida, USA, ²Florida Inst. of Technology, USA, ³Univ. of Washington, USA*. The electric near-field distribution on a dipole-coupled co-planar strip line is measured at 28.3 THz. The attenuation and propagation constants are determined by fitting the standing wave equation to the measured data.

ITuA2 • 8:40 a.m. Invited

Towards Photon Counting X-Ray Image Sensors, *Bart Dierickx^{1,2}, Benoit Dupont¹, A. Defernez¹, P. Henckes²; ¹Caeleste CVBA, Belgium, ²Vrije Univ. Brussels, Belgium*. Photon counting prevails over charge integration, for medical X-ray imaging. Yet realization is hindered by technical and economical factors. The question is: what does it take to make a photon counting X-ray sensor?

ITuA3 • 9:20 a.m. Invited

Nanophotonics for Solid-State Imaging, *Peter B. Catrysse, Lieven Verslegers, Christian C. Fesenmaier, Yijie Huo; Stanford Univ., USA*. I explore the challenges and opportunities for nanophotonics that have emerged in solid-state image sensors as pixel size is scaling down to the single wavelength range following scaling of feature sizes in advanced semiconductor processes.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits Open, Pavilion

Canyon IPhotonic Metamaterials
and Plasmonics**Finger Rock**Optical Remote Sensing of
the Environment**Canyon III**

Optics for Solar Energy

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.**8:00 a.m.–10:00 a.m.****MTuA • Metamaterials II***Harald Giessen; 4th Physics Inst., Univ. of Stuttgart, Germany, Presider***MTuA1 • 8:00 a.m. Invited**Coupling in Metamaterials: Friend or Foe? *Ekaterina Shamonina; Univ. of Erlangen-Nuremberg, Germany. Abstract not available.***MTuA2 • 8:40 a.m.**Photonic Band Structure of Dispersive Metamaterials Formulated as a Hermitian Eigenvalue Problem, *Aaswath Raman, Shanhui Fan; Stanford Univ., USA.* We formulate the photonic band structure calculation of any lossless dispersive metamaterial as a Hermitian eigenvalue problem. We further show that the orthonormal basis formed by the lossless eigenmodes rigorously models lossy dispersive systems.**MTuA3 • 9:00 a.m.**Hyperbolic Metamaterial Route to Engineer the Photonic Density of States, *Zubin Jacob, Ji-Young Kim, Gururak V. Naik, Evgenii Nnariananov, Alexandra E. Boltasseva, Vladimir M. Shalaev; Purdue Univ., USA.* We demonstrate the decrease in the spontaneous emission lifetime of dye molecules due to the enhanced photonic density of states (PDOS) of a hyperbolic metamaterial (HMM), opening the route to PDOS engineered HMM devices.**MTuA4 • 9:20 a.m. Invited**Silver-Filled Alumina Membrane: Metamaterial with Hyperbolic Dispersion and Near-Zero Singularity, *M. A. Noginov¹, Yu. A. Barnakov¹, H. Li¹, G. Zhu¹, T. U. Tumkur¹, M. Mayy¹, Z. Jacob², L. Alekseyev², E. E. Narimanov²; ¹Norfolk State Univ., USA, ²Purdue Univ., USA.* We have developed a class of metamaterials - alumina membranes filled with silver nanowires - which have unique physical properties and are potentially suitable for a variety of applications ranging from transformation optics to quantum optics.**8:00 a.m.–10:00 a.m.****OTuA • Remote Sensing of Vegetation***John Cipar; AFRL, USA, Presider***OTuA1 • 8:00 a.m. Invited**Multi-Source Geospatial Information Integration and Analysis for Coastal Management and Decision Making, *Rongxing Li; Ohio State Univ., USA.* This paper reviews coastal-related research being undertaken at the Mapping and GIS Laboratory, the Ohio State University, on the multi-source geospatial information integration and analysis for coastal management and decision making.**OTuA2 • 8:40 a.m. Invited**Assessing the Extent of Conservation Tillage Using Hyperspectral Imaging, *Craig Daughtry¹, Guy Serbin², P. C. Doraiswamy¹, J. B. Reeves III¹, E. R. Hunt, Jr.¹; ¹US Dept. of Agriculture, USA, ²ASRC Management Service, USA.* Physically-based spectral indices that detect absorption features associated with cellulose and lignin are linearly related to crop residue cover, a key indicator of soil tillage intensity, and are robust across diverse agricultural landscapes.**OTuA3 • 9:20 a.m. Invited**Mapping Coastal Wetlands Using Small-Footprint, Green-Wavelength Lidar, *Amar Nayegandhi; Jacobs Technology Inc., US Geological Florida Integrated Science Ctr., USA.* Full-waveform digitizing of the return pulse using a short-pulse, green-wavelength airborne lidar system provides unprecedented capabilities to map nearshore wetland environments.**8:00 a.m.–10:00 a.m.****STuA • Solar Concentrator Characterization***Joseph E. Ford; Univ. of California at San Diego, USA, Presider***STuA1 • 8:00 a.m. Invited**Direct and Inverse Methods of Characterization of Solar Concentrators, *Antonio Parretta^{1,2}, Giuliano Martinelli¹, Andrea Antonini², Donato Vincenzi¹, C. Privato³; ¹Univ. of Ferrara, Italy, ²ENEA Ctr. Ricerche "E. Clementel", Italy, ³CPower SRL, Italy, ⁴ENEA Ctr. Ricerche Portici, Italy.* We discuss two classes of methods for characterizing solar concentrators (mainly nonimaging): "direct" and "inverse", in relation to the way these are irradiated. We derive the optical collection efficiency under collimated and diffused light.**STuA2 • 8:40 a.m.**SCOTS: A Fast, Inexpensive Test of Solar Concentrators, *Robert Parks; College of Optical Sciences, Univ. of Arizona, USA.* The Software Configurable Optical Test System (SCOTS) is a simple, inexpensive yet highly flexible optical test configurable for almost any specular surface. It consists of a computer generated, patterned display and a digital imaging detector.**STuA3 • 9:00 a.m.**Measurement of Sun-Tracking Accuracy and Solar Irradiance through Multispectral Imaging, *Donato Vincenzi¹, Stefano Baricordi¹, Massimiliano Occhiali¹, Marco Stefancich², Antonio Parretta³, Giuliano Martinelli¹; ¹Univ. of Ferrara, Italy, ²CNR-IMEM, Italy, ³ENEA Ctr. Ricerche "E. Clementel", Italy.* We present the design guidelines and the characterization of a multispectral camera tailored to be used as accuracy measurement device for sun trackers. The camera has been calibrated for direct normal irradiance measurements.**STuA4 • 9:20 a.m. Invited**Tools Development for CPV Characterization Based on CCD Camera Measurements, *Rebeca Herrero Martín, C. Domínguez, I. Antón, S. Askins, G. Sala; Inst. de Energia Solar, Univ. Politécnica de Madrid, Spain.* Two characterization techniques based on a CCD camera have been developed: an inverse illumination method based on cell light emission and a lens deformation analysis method. Its application to a specific CPV technology is presented.**10:00 a.m.–10:30 a.m. Coffee Break/Exhibits Open, Pavilion**

Tuesday, June 8

Sonoran I

Applied Industrial Optics: Spectroscopy, Imaging, and Metrology

Murphey I & II

Digital Image Processing and Analysis

Sonoran II

Imaging Systems

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.**10:30 a.m.–12:30 p.m.****ATuB • Spectroscopy, Color, & Imaging II***Bertrand Lanher; Polarmetrics Corp., USA, President***ATuB1 • 10:30 a.m. Invited**

Use of White LEDs in High Speed Industrial Visible-Light Spectrophotometry Applications, *James Freal; Hunter Lab, USA*. This paper describes the advantages and disadvantages of using white (Ce³⁺:YAG coated) LEDs as light sources in industrial spectrophotometric applications. Various sources are evaluated and a design for a practical spectrophotometer is presented.

ATuB2 • 11:10 a.m.

Sequential Filter Wheel Multispectral Imaging Systems, *Jason M. Eichenholz; Ocean Optics Inc., USA*. The sequential rotating filter wheel is a new approach to multispectral imaging, which offers HDTV quality images with on-board data processing and display at a significant cost and size advantage over conventional hyperspectral imagers.

ATuB3 • 11:30 a.m.

Calibration of a Multi-Object Spectrometer with Programmable and Arbitrary Field of View, *Trine Kirkhus, Britta G. Fismen, Jon Tschudi, Marion O'Farrell; SINTEF ICT, Norway*. Employing digital micro-mirror devices to simultaneously select illumination and detection regions, increases flexibility in spectral measurements. We present a method for collecting regional reference spectra, for optimum accuracy, without compromising the flexibility of the system.

ATuB4 • 11:50 a.m. Invited

A Novel Spectroscopic Technique's Journey of Acceptance in Biopharmaceutical QC Laboratories, *Arthur Watson; Convergent Bioscience Ltd., Canada*. This talk describes our company's journey to gain approval and acceptance in QC laboratories of major biopharmaceutical companies for a novel spectroscopic technique- imaged capillary isoelectric focusing.

10:30 a.m.–12:30 p.m.**DTuB • Medical Image Processing II***Khan Iftekharuddin; Univ. of Memphis, USA, President***DTuB1 • 10:30 a.m. Plenary**

Title to Be Announced, *Joseph O'Sullivan; Washington Univ. in St. Louis, USA*. Abstract not available.

DTuB2 • 11:30 a.m.

Comparative Study of Feature Measures for Histopathological Images of the Lung, *Ravi K. Samala, Venkata S. Potunuru, Jianying Zhang, Sergio D. Cabrera, Wei Qian; Univ. of Texas at El Paso, USA*. Texture features of histopathological images of lung carcinoma have been evaluated using gray level co-occurrence matrices and multi-wavelets. The investigation is done from a pathological perspective resulting in optimum subset of features for classification.

DTuB3 • 11:50 a.m.

Adc Estimation in Multi-Scan DWMRI, *Abhinav K. Jha¹, Matthew A. Kupinski¹, Jeffrey J. Rodriguez², Renu M. Stephen³, Alison T. Stopeck³; ¹College of Optical Sciences, Univ. of Arizona, USA, ²Dept. of Electrical and Computer Engineering, Univ. of Arizona, USA, ³Arizona Cancer Ctr., Univ. of Arizona, USA*. A maximum-likelihood-based scheme for estimating the Apparent Diffusion Coefficient (ADC) value in diffusion-weighted MRI is presented, using which data from multiple scans acquired at the same diffusion-gradient value can be used for accurate ADC computation.

DTuB4 • 12:10 p.m.

Attenuation Correction in Fluorescent X-Ray Computed Tomography Using Synchrotron Incident Sheet-Beam, *Tetsuya Yuasa¹, Shunsuke Nakamura¹, Qingkai Huo¹, Tohoru Takeda², Avraham Dilmanian³; ¹Yamagata Univ., Japan, ²Kitasato Univ., Japan, ³Brookhaven Natl. Lab, USA*. We first clarify the measurement process of fluorescent X-ray computed tomography using synchrotron sheet-beam. Then, we propose the analytical reconstruction method, and show its efficacy by computer simulation.

10:30 a.m.–12:30 p.m.**ITuB • Imaging Sensors II***Glenn D. Boreman; Univ. of Central Florida, USA, President***ITuB1 • 10:30 a.m. Invited**

Curved Focal Plane Arrays: Advantages and Fabrication Using a MEMS Post-Process *Peter Peumans; Stanford Univ., USA*. Abstract not available.

ITuB2 • 11:10 a.m. Invited

High Speed CMOS Pixel Physics and Electronics, *Boyd Fowler; Fairchild Imaging, USA*. Abstract not available.

ITuB3 • 11:50 a.m. Invited

Resolution Limits in Digital Photography: The Looming End of the Pixel Wars, *Rick Baer; Aptina Imaging, USA*. Diffraction and motion blur limit impose limits on pixel size and therefore on digital camera resolution. Photographic utility is actually a better metric for camera comparisons than resolution.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

Canyon IPhotonic Metamaterials
and Plasmonics**Finger Rock**Optical Remote Sensing of
the Environment**Canyon III**

Optics for Solar Energy

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.**10:30 a.m.–12:30 p.m.****MTuB • Plasmonics III***Richard Van Duynne; Northwestern Univ., USA, Presider***MTuB1 • 10:30 a.m.**

Luminescence Quenching Due to High-Order Surface Plasmon Modes of Metal Nanoparticles, *Jacob Khurgin¹, Greg Sun²; ¹Johns Hopkins Univ., USA, ²Univ. of Massachusetts at Boston, USA.* Our model of high-order SP modes supported by metal nanoparticles provides analytical treatment of luminescence quenching and can be used to optimize nanoparticle size and its separation from the emitter to yield maximum enhancement factor.

MTuB2 • 10:50 a.m.

Coupled-Mode Theory of Plasmonic Field Enhancement in Complex Metal Nanostructures, *Greg Sun¹, Jacob Khurgin²; ¹Univ. of Massachusetts at Boston, USA, ²Johns Hopkins Univ., USA.* Theoretical model capable of analytical estimate of plasmonic field enhancement in complex metal structures is developed. When applied to metal nano-clusters the model predicts same order enhancement in the nano-gaps and near the tips.

MTuB3 • 11:10 a.m. Invited

Plasmonic Nanodevices for Single Molecule and Atto Molar Detection, *Enzo Di Fabrizio; Italian Inst. of Technology, Italy.* Different plasmonic based devices are fabricated using novel micro and nano-fabrication techniques for single molecule detection: Self-similar Ag-nanosphere based plasmonic devices, device comprising tapered nanolens and, Si micropillars based superhydrophobic surface.

MTuB4 • 11:50 a.m.

Second Harmonic Generation from a Single Gold Nanoparticle, *Jérémy Butet, Julien Duboisset, Guillaume Bachelier, Isabelle Russier-Antoine, Christian Jonin, Emmanuel Benichou, Pierre-François Brevet; Univ. Claude Bernard Lyon1 - CNRS, France.* Second Harmonic Generation from a single gold nanoparticle in a homogeneous matrix is reported for the first time and compared to ensemble measurements in solution and Finite Elements Method simulations.

MTuB5 • 12:10 p.m.

Cathodoluminescence Imaging of Plasmonic Modes of Ag Nanostructures, *Anil Kumar; Univ. of Illinois at Urbana-Champaign, USA.* We report cathodoluminescence spectroscopy on Ag triangular nanostructures with specially designed substrates having near-vacuum index and low luminescence. FDTD simulations were carried out to predict the role of substrate and the experimentally observed out-of-plane mode.

10:30 a.m.–12:30 p.m.**OTuB • Environmental Applications***Marcos J. Montes; NRL, USA, Presider***OTuB1 • 10:30 a.m.**

Evolution of Vegetation First Derivative Spectra over the Summer-to-Autumn Transition, *John Cipar, Thomas Cooley; AFRL/RVBYH, USA.* We use derivative analysis to study changes in reflectance during the period of deciduous leaf senescence between summer and autumn. Temporal changes are caused by loss of light-absorbing chlorophyll, allowing scattering to dominate reflectance characteristics.

OTuB2 • 10:50 a.m. Invited

Evaluating Materials of Environmental Concern Using Hyperspectral Imaging, *Gregg Swayze; US Geological Survey Spectroscopy Lab, USA.* Imaging spectroscopy has been successfully used to aid researchers in characterizing potential environmental impacts posed by acid-rock drainage, Katrina related oil spills, and asbestos in serpentine mineral deposits and urban dust.

OTuB3 • 11:30 a.m.

Holographic Sensors for Environmental Monitoring, *Izabela G. Naydenova¹, Svetlana Mintova², Suzanne Martin¹, Vincent Toal²; ¹Dublin Inst. of Technology, Ireland, ²Lab Catalyse and Spectrochimie (LCS), ENSICAEN, Univ. de Caen, CNRS, France.* The properties of holographic sensors for environmental monitoring fabricated in zeolite doped photopolymerisable nanocomposites have been studied. The sensors based on volume transmission holograms have been theoretically modelled and their sensitivity have been discussed.

OTuB4 • 11:50 a.m.

Using Hyperspectral Vegetation Indices as a Proxy to Monitor Soil Salinity, *Ting-Ting Zhang; Inst. of Biodiversity Science, Fudan Univ., China.* For monitoring soil salinity, the potential of various hyperspectral vegetation indices were investigated. Furthermore, the most sensitive band combinations to salt-stress were identified and developed into a satisfied and specific salinity index for heterogeneous vegetation.

OTuB5 • 12:10 p.m.

The Advanced Analyst Exploitation Environment, *Jake Clements, Colin Doody, John Schott, Karl Walli; Rochester Inst. of Technology, USA.* In this paper we discuss model building and data fusion through photogrammetry, advanced forms of exploitation through simple math and stats models, and the advantages of integrating these together in an interactive computer gaming environment.

10:30 a.m.–12:30 p.m.**STuB • Concentrator Design and Holographic Concentrator Systems***R. John Koshel; Univ. of Arizona, USA, Presider***STuB1 • 10:30 a.m. Invited**

Paper Withdrawn

STuB2 • 11:10 a.m.

Dual Aperture Holographic Planar Concentrator Photovoltaic Module Energy Harvesting Performance, *Juan M. Russo, Jose E. Castillo Aguilera, Glenn Rosenberg; Prism Solar Technologies, Inc., USA.* Dual aperture holographic planar concentrator modules are compared to single aperture modules. Direct-current IV and alternating-current power curves are presented and used to compare modules with similar silicon active area and cell efficiency.

STuB3 • 11:30 a.m.

Planar Holographic Solar Concentrators for Low and Medium Ratio Concentration System, *Jose M. Castro, Deming Zhang, Raymond Kostuk; Univ. of Arizona, USA.* We analyze two planar holographic solar concentrator designs for low and medium concentration ratio applications. This type of solar concentrators can provide concentration and spectral filtering in a small form factor concentrator configuration.

STuB4 • 11:50 a.m.

Reduced Temperature of Holographic Planar Concentrators, *Jose E. Castillo, Juan M. Russo, Starr Herr-Cardillo, Rakesh Kumar, Glenn Rosenberg; Prism Solar Technologies, Inc., USA.* We present the temperature data for several examples of holographic planar concentrators. The extended holographic regions act as radiative transfer surfaces which reduce the temperature of the cells used with the concentrating film.

STuB5 • 12:10 p.m.

Seasonal and Low Light Performance of a Dual Aperture Holographic Planar Concentrator Photovoltaic Module, *Juan M. Russo, Jose E. Castillo, Eric Aspnes, Glenn Rosenberg; Prism Solar Technologies, Inc., USA.* Dual aperture holographic planar concentrator modules are compared to single aperture modules for a seasonal period of nine months. Seasonal, clear and cloudy day power and energy curves are presented to compare the modules.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

2:00 p.m.–4:00 p.m.

JTua • Joint AIO/IS/META/ORS Poster Session

JTua1

Materials for Infrared Surface Plasmon Resonance Biosensor, Justin W. Cleary¹, Robert E. Peale¹, Glenn D. Boreman¹, Isaiiah Oladeji², Richard Soref³, Walter R. Buchwald³, ¹Univ. of Central Florida, USA, ²Sisom Thin Films, USA, ³Hanscom Air Force Base, USA. Silicides, heavily-doped semiconductors, and semimetals are investigated theoretically and experimentally as surface plasmon hosts for infrared surface plasmon resonance biosensors. Tighter IR mode confinement than for usual Au gives better overlap with biological analytes.

JTua2

Observations of UV Extraordinary Optical Transmission and Localized Field Enhancement through Nanoslits, Qiaoqiang Gan, Liangcheng Zhou, Volkmar Dierolf, Filbert Bartoli, Lehigh Univ., USA. The UV extraordinary optical transmission through nanoslit structures in the far-field and localized field enhancement in the near-field are both directly observed. Numerical modeling results are also presented, showing good agreement with the experiment results.

JTua3

Control of the Fluorescence Features of a Dipole Emitter with Coupled Plasmonic Modes, Cédric Vandenberg¹, David Brayer², Luis S. Froufe-Pérez³, Rémi Carminati³, ¹Univ. of Namur, Belgium, ²ESPCI ParisTech, France, ³Inst. de Ciencia de Materiales, CSIC, Spain. Based on the concept of plasmon hybridization, we study the control of the fluorescence characteristics of a dipole emitter near dimers and metallic thin films. Spectral control can be achieved with nanometer scale spatial sensitivity.

JTua4

3-D Hybrid Plasmonic Waveguide Components with Outstanding Performance, Hong-Son Chu, Er-Ping Li, Ping Bai, Wolfgang Johannes Reinhard Hoefler; A*STAR-Inst. of High Performance Computing, Singapore. Novel hybrid plasmonic waveguide consisting of a SiO₂-stripe sandwiched between a Si-nanowire and a silver-film is used to design different bends and ring resonators. Their superior performance makes them promising building blocks for integrated plasmonics.

JTua5

Three-Dimensional Metamaterial Nanotips, Stefan Mühligh¹, Carsten Rockstuhl¹, Falk Lederer¹, Constantine Simovski², Jacek Pniewski³, ¹Inst. of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller-Universität Jena, Germany, ²Dept. of Radio Science and Engineering / SMARAD, Helsinki Univ. of Technology, Finland, ³Faculty of Physics, Univ. of Warsaw, Poland. We investigate the optical properties of a three-dimensional metamaterial nanotip containing a large number of densely packed metallic nanospheres. The different eigenmodes sustained by the structure and their peculiar polarization state are revealed.

JTua6

Self-Imaging Effect in Plasmonic Multimode Waveguides, André G. Edelmann, Stefan F. Helfert, Jürgen Jahns, Fern Univ. in Hagen, Germany. Numerical studies of the self-imaging phenomenon ("Talbot-effect") as an example of multimode propagation in plasmonic waveguides were performed. For a suitable choice of the parameters the field remains finite after several Talbot lengths.

JTua7

Quest for the Elusive Lossless Metal, Jacob B. Khurgin¹, Gregory Sun²; ¹Johns Hopkins Univ., USA, ²Univ. of Massachusetts at Boston, USA. Metals that are lossy at low frequencies can become lossless in mid-infrared once the inter-atomic distances exceed certain value. While this condition is not met in Nature, advances in nanoassembly may render lossless metals feasible.

JTua8

Angle and Polarization Dependent Tuning of Plasmonic Spectra in Nanoparticle Arrays: Towards Active Plasmonics, Bala Krishna Juluri, Yue Bing Zheng, Qingzhen Hao, Lasse Jensen, Tony Jun Huang; Pennsylvania State Univ., USA. We report two plasmonic platforms that provide dynamic tuning of extinction spectra. These platforms are based on Au nanodisc arrays where changing the angle and polarization of incidence light cause continuous shift of extinction spectra.

JTua9

Sensitive Optical Sensing Using Vertical Plasmonic Mach-Zehnder Interferometer, Qiaoqiang Gan, Yongkang Gao, Filbert Bartoli; Lehigh Univ., USA. By observing the wavelength shift of the peaks or valleys of the SPP interference pattern, a highly compact vertical plasmonic Mach-Zehnder interferometer with a potential to achieve a very high sensitivity is proposed.

JTua10

All-Angle Negative Refraction in Quartz, Rizia R. da Silva¹, Thomas Dumelow¹, José A. P. da Costa¹, Sara B. Honorato², Alejandro P. Ayala³; ¹Univ. do Estado do Rio Grande do Norte, Brazil, ²Univ. Federal do Ceará, Brazil. We investigate all-angle negative refraction in quartz crystals at far infrared wavelengths. This is possible due to the material's anisotropic phonon response. The predicted behavior is consistent with experimental results.

JTua11

The Optical Mechanical Analogy—from Fundamentals to Applications, Dentsho A. Genov¹, Shuang Zhang², Xiang Zhang²; ¹Louisiana Tech Univ., USA, ²Univ. of California at Berkeley, USA. We propose to link the fields of optical metamaterials and celestial mechanics, opening the way to investigate light phenomena reminiscent of orbital motion, strange attractors and chaos, in a controlled laboratory environment.

JTua12

Photonic Metamaterial Absorber Designs for Infrared Solar-Cell Applications, Kamil Boratay Alici, Ekmel Ozbay; Bilkent Univ., Turkey. We propose a metamaterial based absorber design that operates at the infrared regime. The absorption peak was 83.6%. We can incorporate solar-cell layers inside the metamaterial absorber in order to significantly increase solar-cell efficiency.

JTua13

Plasmonic Multimode Waveguides with Transversely Structured Core, André G. Edelmann, Stefan F. Helfert, Jürgen Jahns, Fern Univ. in Hagen, Germany. We analyze plasmonic multimode waveguides with transverse structured core using different metals. This allows one to influence the propagation and attenuation characteristics of specific eigenmodes. We show numerical results based on two core designs.

JTua14

The Generation of Airy-Type Surface Plasmon Polaritons, Dai Haitao^{1,2}, X. W. Sun¹; ¹Nanyang Technological Univ., Singapore, ²Fudan Univ., China. We demonstrated an approach to generate Airy-type surface plasmon polaritons (AISPPs) by binary plasmonics elements. The propagation dynamics of AISPPs achieved by binary plasmonics method are demonstrated numerically utilizing full-vector Huygens-Fresnel principle.

JTua15

Design Optimization of Transition Metamaterials, Tolanya Gibson¹, Matthew Pennybacker², Irene Mozjerin¹, Ildar Gabitov², Vladimir Shalaev³, Natalia Litchinitser¹; ¹SUNY Buffalo, USA, ²Univ. of Arizona, USA, ³Purdue Univ., USA. We report a detailed study of the effect of the graded index transition metamaterials design parameters on the resonant absorption of the obliquely incident electromagnetic wave in the vicinity of the zero index transition point(s).

JTua16

Plasmonic Nanoparticles Manipulating Solar Systems: A Dipole Mode-Complex Image Analysis, Mohammad M. Tajdini, Shabnam Ghadarghadar, Hossein Mosallaei; Northeastern Univ., USA. This paper presents an efficient technique for modeling large array of plasmonic particles deposited on layered substrate, offering energy-efficient solar-systems. Dipole Mode (DM) theory along with Complex Image (CI) technique will characterize the performance successfully.

JTua17

Controlling Metamaterials with Light, Sangeeta Chakrabarti, S. Anantha Ramakrishna, Harshwardhan Wanare; Indian Inst. of Technology Kanpur, India. Control over the magnetic response of SRR-based and plasmonic metamaterials, accompanied by reduced dissipation, is demonstrated using coherent optical processes. Further, we show how such processes induce propagating modes in plasmas, below their plasma frequency.

JTua18

Novel Nanotechnology for a Fine Plasmon Wavelength Tuning, Rita Najjar¹, Salim Boutami¹, Cyril Cayron¹, Viviane Muffato¹, Alistair Kearn², Srinivas Saranu², Rudi Santbergen², Etienne Quesnel³; ¹CEA, France, ²MANTIS, UK, ³Delft Univ. of Technology, Netherlands. Control of silver nanoparticles characteristics using a dedicated nano-clusters source and wavelength tuning of Plasmon resonance generated by small nanoparticles using different matrices. The results have been validated by advanced surface Plasmon modeling.

JTua19

Terahertz Response High Conductivity Copper-Clad Polyimide Metamaterials, Yew Li Hor; Inst. of High Performance Computing, Singapore. This paper demonstrates a cost effective mass production of terahertz response metamaterials utilizing direct to copper-clad-polyimide Microfluidic-jetted deposition. The fabricated structures are characterized using THz time-domain spectroscopy within 0.1 to 2 THz in transmission mode.

JTua20

Paper Withdrawn

JTua21

Determination of Negative Permittivity, Permeability and Refraction of Metamaterials, Mondher Labidi, Jamel Belhadj Tahar, Fethi Choubani; Res. Unit Systems of Telecommunications (6Tel), SUP'COM, Tunisia. In this paper we analyze the reflection and transmission coefficients calculated from transfer matrix simulations on finite lengths of electromagnetic metamaterials, to determine the effective permittivity ϵ , permeability μ and refractive index n .

JTua22

Field Enhancements and Directivities of Plasmonic Interference Nanostructures with Two Localized Hot Spots, Hsin-Hung Cheng¹, Ying-Yu Chang¹, Jia-Han Li¹, Jen-You Chu², Ding-Zheng Lin², Yi-Ping Chen²; ¹Natl. Taiwan Univ., Taiwan, ²Industrial Technology Res. Inst., Taiwan. The finite-difference time-domain method is used to study the field enhancements and directivities of plasmonic nanostructures with two localized hot spots. The plasmonic far field interference can be predicted well by Young's double slit formula.

JTua23

An Artificial Negative Index Film Applied to near-Filed Optical Storage with a Solid Immersion Lens, Taikei Suyama¹, Yaoju Zhang², Yoichi Okuno¹; ¹Graduate School of Science and Technology, Kumamoto Univ., Japan, ²College of Physics and Electronic Information, Wenzhou Univ., China. We report a new method of enhancing the intensity of spot of near-field optical storage system with solid immersion lens. This method is based on surface plasmas excited by a real artificial negative index film.

2:00 p.m.–4:00 p.m.

JTU • Joint AIO/IS/META/ORS Poster Session—Continued

JTUA24

Total Variation Adaptive Scene-Based Nonuniformity Correction, Esteban Vera, Pablo Meza, Sergio Torres; Univ. of Concepcion, Chile. We propose an adaptive scene-based nonuniformity correction method based on the minimization of the total variation of the estimated irradiance, which provides enhanced results in both simulated and real infrared imagery, showing less ghosting artifacts.

JTUA25

Modeling of 2-D/3-D Ladar Systems: Experimental Assessment, Laurent Hespel, Guillaume Anna, Nicolas Riviere, Aurelie Bonnefois, Marie Therese Velluet, Dominique Hamoir; ONERA, France. We developed two numerical models to address respectively, 2-D Flash and 3-D Ladar imaging. After a short description of the models used, a comparison of numerical and experimental results is conducted.

JTUA26

The Digital Camera is an Imaging System, Joyce Farrell, Peter Catrysse, Brian Wandell; Stanford Univ., USA. We describe methods for simulating the complete image processing pipeline of a digital camera, including the scene, optics, sensor, processing and display output.

JTUA27

Reproduction of Scenes Using Duplicate Physical Structures, Syed Qasim Bukhari; Univ. de Granada, Spain. Reproduction of original structure means creating a physical structure, exactly equal in shape and appearance, producing same visual sensation as of the original. In this paper we describe such reproduction.

JTUA28

Coastal Vegetation Mapping from Hyperspectral Imagery, Krista Lee¹, Charles M. Bachmann², Robert A. Fusina², Marcos J. Montes², Rong-Rong Li², John C. Fry³, C. Reid Nichols³, Christopher Parrish⁴, Jon Sellars⁵; ¹Naval Postgraduate School, USA, ²NRL, USA, ³Marine Information Resource Corp., USA, ⁴NOAA/NOS, USA. Leaf and canopy level reflectance have been measured by us in an ongoing effort to characterize coastal vegetation in a variety of coastal types. We compare results of these efforts for coastal vegetation mapping.

JTUA29

An Automated Hybrid Approach to Large Area Land Use Classification and Change Detection, Francis Padula, Julia L. MacDonough, Dan Bondy, Monica Cook; Integrity Applications, Inc., USA. An automated, supervised Gaussian Maximum Likelihood classifier which leveraged a priori scene knowledge from MODIS was developed to rapidly identify and exploit large area land use change over time using Global Landsat Survey data.

JTUA30

Tropical Woodland Biomass Burning and Carbon Emission: A Case Study in Sudan, Weicheng Wu, Eddy De Pauw; Intl. Ctr. for Agricultural Res. in the Dry Areas, Syrian Arab Republic. This paper reports on an assessment of woodland burning, biomass loss and carbon emission into atmosphere in a tropical African savannah based on multi-source image processing and woody biomass models developed earlier by the authors.

JTUA31

Assessment of Surface Deformation in Pamir-Alai Region Due to Nura Earthquake Using InSAR, Kanayim O. Teshebaeva, Aleksander Zybovich; Central Asian Inst. for Applied Geosciences, Kyrgyzstan. Analysis of ALOS and PALSAR images before and after Nura earthquake to assess deformation in earth surface shows 188cm LOS deformation with low coherence in some images while observed fringe pattern shows uplift and subsidence.

JTUA32

Direct Correlation between Anthropogenic Ozone Production and Ethylene in the Urban Atmosphere, Taieb Gasmî; Div. of Sciences and Engineering, Saint Louis Univ. at Madrid, Spain. Correlation between ozone concentration and ethylene in the urban atmosphere is both demonstrated and supported by a photochemical smog model. Experimental results hence ascertain that ethylene as hydrocarbon plays a role in tropospheric ozone generation.

JTUA33

Toward the Development of a Hierarchical Coastal Classification System—An Example from the Mariana Islands, John C. Fry¹, Michael D. Duncan², Charles M. Bachmann³, C. Reid Nichols³; ¹Marine Information Resources Corp., USA, ²NAVFAC Marianas, USA, ³NRL, USA. Abstract not available.

JTUA34

Submicron Displacement Measurement by Measuring Autocorrelation of the Transmission Function of a Grating, Khosro Madanipour¹, Mohammad Taghi Tavassoly²; ¹Amirkabir Univ. of Technology, Islamic Republic of Iran, ²Univ. of Tehran, Islamic Republic of Iran. It is shown by measuring the autocorrelation of the transmission function of gratings of pitches in order of sub millimeter, submicron displacements can be measured. This technique is not expensive, complicated and sensitive to vibration.

JTUA35

3-D Profile Reconstruction of Surface Based on Projection of a Single Fringe Pattern and Ftp Analysis, Fateme Mohammadi, Amir Hossein Rezaie, Khosro Madanipour; Amirkabir Univ. of Technology, Islamic Republic of Iran. We present simple but very efficient technique for 3-D profilometry of surface. A videoprojector projects a single fringe pattern on a surface. By applying Fourier Transform analysis and phase unwrapping, the 3-D profile can be reconstructed.

JTUA36

Measurement of Heat Transfer Coefficient and Temperature Profile around Axisymmetric Objects by Moiré Deflectometry, Fatemeh Salimi Meidaneshahi¹, Khosro Madanipour², Babak Shokri¹; ¹Shahid Beheshti Univ., Islamic Republic of Iran, ²Amirkabir Univ. of Technology, Islamic Republic of Iran. The spatial temperature distribution and heat transfer coefficient have been measured by moiré deflectometry. This technique can be applied to measure temperature distribution, refractive index of transparent axisymmetric plasmas and for optimum design of instruments.

2:00 p.m.–4:00 p.m.

STuC • Coatings and Light Trapping

Martha Symko-Davies; Natl. Renewable Energy Lab, USA, Presider

STuC1 • 2:00 p.m. **Invited**

Large Area Optical and Opto-Electronic Thin Film Applications, Mark George; General Plasma Inc., USA. In this paper we review the predominate large area thin film coating technologies used for manufacture of optical solar devices. We discuss typical film properties and their technical challenges for several important solar applications.

STuC2 • 2:40 p.m.

2-D Blazed Grating for Light Trapping in Thin Silicon Solar Cells, Jo Gjessing^{1,2}, Aasmund Sudbo³, Erik Stensrud Marstein¹; ¹Inst. for Energy Technology, Norway, ²Dept. of Physics, Univ. of Oslo, Norway, ³Univ. Graduate Ctr. at Kjeller, Norway. We propose a novel sub-micron back-side grating for light trapping in thin silicon solar cells. The 2-D-blazed grating has the potential to increase the optical thickness of the solar cell by a factor of 17.

STuC3 • 3:00 p.m.

A Scattering Model for Transparent Thin Films with Surface Textures, Klaus Jaeger, Miro Zeman; Delft Univ. of Technology, Netherlands. Scattering properties of surface-textured thin films that are used in thin-film silicon solar cells, such as angular intensity distribution and haze, were calculated with the scalar scattering theory. Good agreement with measured data was achieved.

STuC4 • 3:20 p.m. **Invited**

Anti Reflection Coating Optimization for Concentrator Solar Cells, Marta Victoria, C. Domínguez, I. Antón, G. Sala; Inst. de Energia Solar, Univ. Politécnica de Madrid, Spain. When optimizing antireflection coating for concentrator solar cells, the incidence angles distribution and the broad spectral bandwidth, must be considered. Here, numerical optimization of ARC layer thicknesses and spectral transmission characterization are presented.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits Open, Pavilion

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

4:30 p.m.–6:30 p.m.

ATuC • Chemical Sensing

Jess Ford; Weatherford Intl., USA, *Presider*

ATuC1 • 4:30 p.m. **Invited**

Title to Be Announced, Ken Johnson; Georgia Tech Res. Inst., USA. Abstract not available.

ATuC2 • 5:10 p.m.

Taking Front-Face Fluorescence-Based Measurement of Lipid Oxidation out of the Lab, Marion O'Farrell¹, Britta G. Fismen¹, Jon Tschudi¹, Diego Airado-Rodríguez², Jens Petter Wold²; ¹Sintef ICT, Norway, ²Nofima Mat AS, Norway. This paper presents a low-cost, at-line, front-face fluorescence system, for measuring lipid oxidation in food products. It will be used to determine the quality of the food by measuring the level of rancidity.

ATuC3 • 5:30 p.m.

Investigation of Hexagonal Boron Nitride by Terahertz Time-Domain Spectroscopy, Jon Leist¹, Mira Naftaly², Richard Dudley²; ¹Momentive Performance Materials, Inc., USA, ²Natl. Physical Lab, UK. Four grades of hexagonal boron nitride have been investigated using terahertz time-domain spectroscopy. Optical properties at terahertz frequencies were found to be related to material structure and physical properties.

ATuC4 • 5:50 p.m.

Identification and Quantification of Maple, Corn Starch and Cane Syrup in "Maple Syrup" Products Using FTIR-ATR Spectrometry, Bertrand Lanher; Polarmetrics Corp., USA. Abstract not available.

ATuC5 • 6:10 p.m.

Analysis of Tequila Extracts by Solid Phase Extraction Combined with ATR-FTIR Spectroscopy, Oracio Barbosa-García, Nancy Ornelas-Sota, Marco A. Meneses-Nava, Gabriel Ramos-Ortiz, Jose L. Maldonado, Juan L. Pichardo-Molina; Ctr. de Investigaciones en Óptica, A.C., Mexico. Infrared spectroscopy combined with chemometric tools, was used for differentiate rested tequila brands. The main solid compounds of tequila were obtained by a pre-concentration of commercial samples through use of the solid phase extraction technique.

4:30 p.m.–5:30 p.m.

ITuC • Imaging Sensors III

Michael Kriss; MAK Consultants, USA, *Presider*

ITuC1 • 4:30 p.m. **Invited**

Surveillance of Dynamic Threats in Complex Urban Environments, Michael Eismann; AFRL, USA. The Air Force Research Laboratory is developing advanced EO/IR sensing concepts for urban surveillance including hyperspectral change detection, infrared wide area surveillance, and feature-aided target tracking in complex, culturally-cluttered areas.

ITuC2 • 5:10 p.m.

Gigagon: A Monocentric Lens Design Imaging 40 Gigapixels, Daniel L. Marks, David J. Brady; Duke Univ., USA. The Gigagon is a f/2.5 five element monocentric lens resolving under 2 arcsec over a 120 degree field of view intended to image onto megapixel sensors tiled over the focal surface.

Canyon III

7:00 p.m.–7:45 p.m.
STuE • SOLAR Poster Session

STuE1

Theoretical Aspects of Light Collection in Solar Concentrators, Antonio Parretta^{1,2}, Letizia Zampierolo¹, Dario Roncati²; ¹Univ. of Ferrara, Italy, ²ENEA Ctr. Ricerche "E. Clementel", Italy, ³O.C.E.M. S.p.A., Italy. The theory of light collection in solar concentrators irradiated in the "direct" mode (from input aperture) is revisited and new concepts are introduced. Application of the theory is made mainly to nonimaging (CPC) concentrators.

STuE2

Theory of the "Inverse Method" for Characterization of Solar Concentrators, Antonio Parretta^{1,2}, D. Roncati²; ¹Univ. of Ferrara, Italy, ²ENEA Ctr. Ricerche "E. Clementel", Italy, ³O.C.E.M. S.p.A., Italy. The theory of "inverse method" applied to the optical characterization of solar concentrators is revisited. New optical quantities are introduced and the experimental procedure for measuring the on-axis absolute "direct" transmission efficiency is reported.

STuE3

Acceptance Angle and Illumination Uniformity for Overfilled Optical Concentrators, Alan R. Kost^{1,2}, Katherine X. Liu², Charles Qian²; ¹Univ. of Arizona, USA, ²All Optronics Inc., USA. Solar concentrators are frequently characterized by an acceptance angle that specifies optical throughput when the concentrator is misaligned. Here we introduce an effective acceptance angle that includes the effect of illumination non-uniformity on system performance.

STuE4

Chromatic Aberration and Attenuation Properties of Water-Based Rod Optical Waveguides for Use in Hybrid Solar Energy Systems, Scott Shepard; Univ. of Central Florida, USA. We analyze a variety of optical filtering technologies and find that water-based rod waveguides can provide a cost effective alternative to the use of optical fiber for improving the performance of hybrid photovoltaic/solar-thermal systems.

STuE5

Synthesis And Characterization of Kiton Red Doped ZnO Nanorod Arrays for Solar Cell, Fozia Z. Haque¹, Lokesh Shastri¹, Mushahid Husain²; ¹M.A.N.I.T., BHOPAL, India, ²J.M.I., NEW DELHI, India. Kiton red dye sensitized solar cell (DSSC) using ZnO nanoparticle and nanorods grown on FTO substrate provides a credible alternative concept to present day photovoltaic device. Nanoparticles were investigated through SEM, XRD and I-V study.

STuE6

Growth and Characterization of CuO Nano-Structures by Electrochemical Process, Juan A. Aguilar¹, M. Guzmán², S. Fuentes¹, S. Aguilera¹, R. A. Zarate¹; ¹Dept. of Physics, Faculty of Science, Univ. Católica del Norte, Chile, ²Dept. of Chemical, Faculty of Science, Univ. Católica del Norte, Chile. It was successfully synthesized CuO thin films strongly adhered to the substrate by an electrochemical treatment of a copper foil submerged in a 1M KOH solution, these films are composed of very diminute fibrous.

Canyon I

Photonic Metamaterials
and Plasmonics

Canyon III

Optics for Solar Energy

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

4:30 p.m.–6:30 p.m.

MTuC • Plasmonics IV

Nicholas Fang; Univ. of Illinois at Urbana-Champaign, USA, *Presider*

MTuC1 • 4:30 p.m. **Invited**

Spatiotemporal Near-Field Control in Nanostructures, *Martin Aeschlimann¹, Michael Bauer², Daniela Bayer³, Tobias Brixner⁴, Stefan Cunovic⁴, Frank Dimler⁴, Alexander Fischer¹, Walter Pfeiffer⁴, Martin Rohmer⁴, Christian Schneider⁴, Felix Steeb⁴, Christian Strüber⁴, Dmitri V. Voronine⁵; ¹Univ. of Kaiserslautern, Germany, ²Univ. Kiel, Germany, ³Univ. Würzburg, Germany, ⁴Univ. Bielefeld, Germany. The high sensitivity and lateral resolution of a photoemission electron microscope is used to verify a scheme for a simultaneous spatial and temporal control of nanooptical fields by means of femtosecond polarization shaped laser pulses.*

MTuC2 • 5:10 p.m.

The Electrodynamics of Light Transmission for Subwavelength Single Apertures and Aperture Arrays, *John Weiner¹, Henri Lezec¹, Domenico Pacifici²; ¹NIST, USA, ²Brown Univ., USA.* Modern nanofabrication tools, coherent light sources, quantitative light measurements, and three-dimensional numerical vector field simulations have led to a radical revision of early claims of “extraordinary transmission” based on classical electrodynamic models and Bloch-state analyses.

MTuC3 • 5:30 p.m.

Modulating Subwavelength Transmission in Nanoaperture Arrays with Metallic Nanoparticles, *Matthew J. Kofke, David H. Waldeck; Dept. of Chemistry, Univ. of Pittsburgh, USA.* Optical transmission through subwavelength nanoaperture arrays can be modulated by metallic nanoparticles that are nested in the nanoaperture. The localized surface plasmon resonance of nanoparticles can strongly modulate and in some cases dominate the transmission.

MTuC4 • 5:50 p.m.

Giant Splitting of Localized Electric and Magnetic Plasmon Modes in a Photonic Microcavity, *Ralf Ameling, Harald Giessen; Univ. of Stuttgart, Germany.* A cut-wire pair is strongly coupled to photonic modes in a microcavity. This results in large anticrossings of the electric and magnetic plasmon modes and the cavity mode dispersion, being useful for plasmon-quantum emitter coupling.

MTuC5 • 6:10 p.m.

Giant Surface-Plasmon-Induced Drag Effect, *Maxim Durach, Anastasia Rusina, Mark Stockman; Georgia State Univ., USA.* We predict a giant surface-plasmon-induced drag-effect rectification (SPIDER). In nanowires, this giant SPIDER generates rectified THz potential up to 10V and electric fields up to 10^5 - 10^6 V/cm. The giant SPIDER is an ultrafast effect.

4:30 p.m.–6:30 p.m.

STuD • Concentrator System Design

Juan Carlos Miñano; LPI, USA, *Presider*

STuD1 • 4:30 p.m. **Invited**

New Optical Concept for Concentrator Photovoltaics, *Roger Angel; Univ. of Arizona, USA.* Sunlight is collected by 3.1 x 3.1 m square dish reflectors. At each focus, light is apportioned by secondary optics onto many cells in a concave array, with each cell receiving the same 1000x concentration.

STuD2 • 5:10 p.m.

Radial Coupling Method for Orthogonal Concentration within Planar Micro-Optic Solar Collectors, *Jason H. Karp, Eric J. Tremblay, Joseph E. Ford; Univ. of California at San Diego, USA.* We present an orthogonal concentration method to further confine sunlight within planar solar collectors. Radial-oriented couplers create micro-optic solar concentrators with >375x geometric concentration and a 20% reduction in guiding loss.

STuD3 • 5:30 p.m.

Low Concentration Planar Holographic CIGS, *Jose E. Castillo, Juan M. Russo, Eric D. Aspnes, Glenn Rosenberg; Prism Solar Technologies, Inc., USA.* We present the results of combining CIGS cells with diffractive film. The film, originally designed for silicon solar applications worked well with the CIGS, yielding a significant boost in performance, especially at low light levels.

STuD4 • 5:50 p.m. **Invited**

Material Choices and Tolerance Budget in the Optical Design of Solar Photovoltaic Concentrators, *Ralf Leutz, Ling Fu, Hans Philipp Ammen; Concentrator Optics GmbH, Germany.* Novel materials (including a thermoformable silicone) for concentrating photovoltaics (CPV) are included in a clear conceptual tolerance budget for the systematic interaction of optical and mechanical design of parquet and module.

Canyon III

7:00 p.m.–7:45 p.m.

STuE • SOLAR Poster Session—Continued

STuE7

Improved Contact Design Methodology for Solar Cells, *Jing-Jing Li, Ding Ding, Swee Hoe Lim, Yong-Hang Zhang; Arizona State Univ., USA.* A rigorous approach to optimize the layout of the front contact under the real working condition of the solar cell is proposed.

STuE8

Optical Biasing Effects on Multijunction Solar Cells, *Swee H. Lim, Kevin O'Brien, Elizabeth H. Steenbergen, Yong-Hang Zhang; Ctr. for Nanophotonics and School of Electrical, Computer and Energy Engineering, Arizona State Univ., USA.* We analyze and demonstrate the electrical and optical characterization techniques for multijunction solar cells to explain and quantify measurement artifacts commonly encountered under practical test conditions.

STuE9

Gold and Silver Colloidal Nanoparticles Deposition on Monocrystalline Solar Cells, *Roberto Villarreal¹, Sandra Fuentes¹, Patricio Leyton², Sara Aguilera¹, Ramon Zarate¹; ¹Univ. Católica del Norte, Chile, ²Univ. Andres Bello, Chile.* The objective of this investigation is enhancement the efficiency of monocrystalline solar cells through the deposition of gold and silver colloidal nanoparticles fabricated with different diameters and with sodium citrate as reductant.

STuE10

A Quasi Gradient-Index Antireflection Coating for Solar Cell, *Chung An Hu¹, T. J. Yang², S. L. Yang²; ¹Natl. Chiao Tung Univ., Taiwan, ²Chung Hua Univ., Taiwan.* A five-layer quasi-parabolic antireflection coat is proposed to improve the conversion efficiency of solar cells. The performance is perfect over a wide wavelength and wide incident angle.

STuE11

Elaboration and Obtainment of Transparent Conductive Diamond Like Carbon Films for Si PV Application, *Armen S. Gharibyan; State Engineering Univ. of Armenia, Armenia.* Transparent, conductive DLC films have been elaborated as replacement of Si PV cells' metallic gratings applying PECVD technology. Conductivity and transparency of films have correspondingly been reached up to $104\text{Ohm}^{-1}\text{cm}^{-1}$ and up to 85%.

8:00 p.m.–9:00 p.m. AIO Rump Session, Sonoran I

8:00 p.m.–9:00 p.m. SOLAR Rump Session, Canyon III

Sonoran II

Imaging Systems

8:00 a.m.–10:00 a.m.

IWA • Computational Imaging I

Todd Sachs; Aptina Imaging Corp., USA, President

IWA1 • 8:00 a.m. **Invited**

A Review of Some Recent Work in the Area of Imaging and Optical Signal Processing, John Sheridan; Univ. College Dublin, Ireland. A review is presented of research recently carried out in our group. Topics discussed include: (i) Imaging through turbulent media; (ii) Numerical algorithms; (iii) Controlling speckle and metrology; (iv) Digital holography; and (v) Optical encryption/multiplexing.

IWA2 • 8:40 a.m.

Coded Strobng Photography for High-Speed Periodic Events, Dikpal Reddy¹, Ashok Veeraraghavan², Ramesh Raskar³; ¹Dept. of Electrical and Computer Engineering, Univ. of Maryland, USA, ²Mitsubishi Electric Res. Labs, USA, ³MIT Media Labs, USA. We capture high-speed periodic events using a low-frame rate camera by temporally modulating the shutter (coded strobing) and demonstrate that the Nyquist rate constraint can be imposed on strobe-rate rather than the sensor-rate.

IWA3 • 9:00 a.m.

Rejecting out-of-Focus Attenuation, Keith J. Dillon, Yeshaiahu Fainman; Univ. of California at San Diego, USA. We consider the confocal microscope for samples where there is predominantly attenuation. We derive a computational detection approach for rejection of attenuation away from the focal point which we compare to the conventional method.

IWA4 • 9:20 a.m.

Modeling the Performance of Turbulence Mitigation Algorithms in Targeting Imagers, Richard L. Espinola, Jae Cha; US Army Night Vision and Electronic Sensors Directorate, USA. Mitigation algorithms can improve the target acquisition performance of imaging systems in atmospheric turbulence. We quantify this improvement using perception tests and develop a model that predicts sensor/observer ID performance with software-based turbulence mitigation algorithms.

IWA5 • 9:40 a.m.

Restoration of Turbulence-Degraded Images Using Pixel Histograms, Guy Potvin, Luc Forand, Denis Dion; DRDC Valcartier, Canada. The most-common method of restoration of turbulence-degraded images restores the sharp edges of an image but makes them jagged. We raise the pixel histograms to a certain order, which creates sharp but straight edges.

Canyon I

Photonic Metamaterials and Plasmonics

8:00 a.m.–10:00 a.m.

MWA • Active Structures

Mikhail Noginov; Norfolk State Univ., USA, President

MWA1 • 8:00 a.m. **Invited**

Active Coated Nano-Particles for Localized Optical Sensors, Richard Ziolkowski; Univ. of Arizona, USA. Active spherical coated nano-particles have been considered for nano-laser, nano-sensor, and optical metamaterial applications. Excitation by plane waves and arbitrarily located electric Hertzian dipoles lead to a rich variety of amplification and cloaking phenomena.

MWA2 • 8:40 a.m. **Invited**

Deep Sub-Wavelength Plasmonic Lasers, Guy Bartal¹, R. F. Oulton¹, V. J. Sorger¹, T. Zentgraf¹, X. Zhang^{1,2}; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA. We show that a hybrid of semiconductor nanowire and metallic surface modes produces an efficient laser device with $\lambda/100$ mode area and discuss the broader impact of plasmon-based light sources and integrated optical components.

MWA3 • 9:20 a.m.

Paper Withdrawn

MWA4 • 9:40 a.m.

Compensation of Losses in Slow-Light Negative-Index Waveguides by Evanescent Pumping, Kosmas L. Tsakmakidis, Edmund I. Kirby, Ortwin Hess; Advanced Technology Inst., UK. Using full-wave simulations we show how the incorporation of thin layers made of an active medium adjacently to the core layer of a negative-index slow-light waveguide can completely remove dissipative optical losses.

Canyon III

Optics for Solar Energy

8:00 a.m.–10:00 a.m.

SWA • Light Trapping and Plasmonics

Allen Barnett; Univ. of Delaware, USA, President

SWA1 • 8:00 a.m. **Invited**

The Influence of the $4n^2$ Light Trapping Factor on Ultimate Solar Cell Efficiency, Eli Yablonovitch, Owen Miller; Univ. of California at Berkeley, USA. The standard Shockley-Queisser approach to ideal ultimate solar cell efficiency makes a number of idealistic assumptions. Under even slightly non-ideal conditions, the $4n^2$ light trapping factor already has a major role controlling the ultimate efficiency.

SWA2 • 8:40 a.m.

Optical Absorption Enhancement in Thin-Film Organic Photovoltaic Solar Cells through the Excitation of Plasmonic Modes in Metallic Gratings, Changjun Min¹, Jennifer Li¹, Georgios Veronis¹, Jung-Yong Lee², Shanhui Fan², Peter Peumans³; ¹Louisiana State Univ., USA, ²Stanford Univ., USA. We theoretically demonstrate up to ~50% enhancement of the overall optical absorption in thin-film organic photovoltaic solar cells in which the top transparent electrode is partially substituted by a periodic metallic grating.

SWA3 • 9:00 a.m.

Optical Enhancement with Plasmonic Nanoparticles in Organic Bulk-Heterojunction Solar Cells, Wee Shing Koh¹, Yuriy Akimov¹, Yuning Li², Mui Siang Soh², Wei Peng Goh², Hong Son Chu¹; ¹Inst. of High Performance Computing, Singapore, ²Inst. of Materials Res. and Engineering, Singapore. This work discusses the enhancement of the optical absorption of the organic bulk-heterojunction solar cell with plasmonic silver nanoparticles.

SWA4 • 9:20 a.m. **Invited**

Randomly Textured Surfaces for Photon Management in Silicon Thin Film Solar Cells, Carsten Rockstuhl, Stephan Fahr, Falk Lederer; Friedrich-Schiller-Univ., Germany. Rigorous diffraction theory is used to reveal the peculiarities of randomly textured surfaces used for photon management. The effect of such surfaces in solar cells with an increasing complexity is analyzed to provide unprecedented insights.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits Open, Pavilion

Sonoran II

Imaging Systems

10:30 a.m.–11:50 a.m.

IWB • Computational Imaging II

Joyce Farrell; Stanford Univ., USA, *Presider*

IWB1 • 10:30 a.m. **Invited**

Superresolution Systems, Ronald Driggers¹, Gisele Bennett²; ¹NRL, USA, ²Georgia Tech Res. Inst., Georgia Tech, USA. Abstract not available.

IWB2 • 11:10 a.m. **Invited**

Computational Photography, Ramesh Raskar; MIT, USA. Abstract not available.

Canyon I

Photonic Metamaterials and Plasmonics

10:30 a.m.–12:30 p.m.

MWB • Metamaterials III

Martin Aeschlimann; Univ. of Kaiserslautern, Germany, *Presider*

MWB1 • 10:30 a.m.

Optical Frequency Negative-Index Material Based on Silver Nanocluster Metamaterial, Venkata A. Tamma, Saumil Joshi, Won Park; Univ. of Colorado, USA. We present theoretical and experimental studies on a new negative-index material based on silver nanocluster metamaterial. A scalable bottom-up approach based on template directed self-assembly was used for fabricating the nanocluster material.

MWB2 • 10:50 a.m.

Optical Isotropic Negative Index Metamaterials, Christoph Menzel¹, Thomas Paul¹, Carsten Rockstuhl¹, Rumen Iliev¹, Andrei Andryieuski², Radu Malureanu², Andrei V. Lavrinenko², Falk Lederer¹; ¹Inst. of Condensed Matter Theory and Solid State Optics, Germany, ²DTU Fotonik - Dept. of Photonics Engineering, Technical Univ. of Denmark, Denmark. In the search for isotropic metamaterials we analyze isofrequency surfaces of the dispersion relation of highly symmetric metamaterials and show that they are optically anisotropic. Instead isotropic metamaterials are achieved by carefully designing multilayer structures.

MWB3 • 11:10 a.m.

Infrared Planar Zero Index Metamaterials, Seokho Yun, Jeremy A. Bossard, Yan Tang, Douglas H. Werner, Theresa S. Mayer; Penn State Univ., USA. An infrared planar Zero Index Metamaterial consisting of a Ag screen surrounded by a polyimide substrate and superstrate that was optimized using a genetic algorithm to have a low/zero refractive index with maximum transmission.

MWB4 • 11:30 a.m.

Multiplexed Plasmonic Nanostructure Metamaterial for Wide Spectral Band Perfect Light Absorption, Junpeng Guo, Yi Zou, Hai S. Leong, Boyang Zhang; Univ. of Alabama at Huntsville, USA. We will present a multiplexed plasmonic nanostructure which can perfectly absorb light over a wide spectral band in the infrared. The nanostructure can provides near 10% over 20 dB light absorption spectral band in infrared.

MWB5 • 11:50 a.m.

Metamaterial Immersion Lenses, Changbao Ma, Zhaowei Liu; Univ. of California at San Diego, USA. We propose and demonstrate metamaterial immersion lenses (MILs) by shaping the interfaces of plasmonic metamaterials. The MILs can achieve super resolution and can be easily integrated with conventional optical systems.

MWB6 • 12:10 p.m.

Silicon Nanorod Based Near-Infrared Ground Plane Cloak, Venkata A. Tamma¹, John Blair², Christopher Summers², Won Park¹; ¹Univ. of Colorado, USA, ²Georgia Tech, USA. An improved implementation of optical frequency ground plane cloak was demonstrated using silicon nanorod array. The cloak performance was directly visualized by the near-field scanning optical microscopy. The experimental data agreed well with numerical simulations.

Canyon III

Optics for Solar Energy

10:30 a.m.–12:30 p.m.

SWB • Light Management and Spectrum Splitting

Cesar Domínguez; Univ. Politécnica de Madrid, Spain, *Presider*

SWB1 • 10:30 a.m. **Invited**

High Efficiency, Spectrum Splitting Solar Cell Assemblies: Design, Measurement and Analysis, Allen Barnett, Xiaoting Wang; Univ. of Delaware, USA. A spectrum splitting photovoltaic architecture was proposed for high energy conversion efficiency. Assemblies of this architecture were constructed, measured and analyzed, which allow assessment of current assemblies and help identify pathways to higher efficiency.

SWB2 • 11:10 a.m.

Design, Assembly, and Testing of a Spectral Splitting Solar Concentrator Module, Eric Christensen, Duncan Moore, Greg Schmidt, Blair Unger; Inst. of Optics, Univ. of Rochester, USA. This paper describes the design, assembly, and testing of a concentrating photovoltaic module which uses spectral splitting to achieve high system power efficiency. An efficiency of 37.5% was measured on a prototype module.

SWB3 • 11:30 a.m.

Optimum Design and Performance Study of Near Infrared Emitting Quantum Dots Luminescent Solar Concentrators, Chunhua Wang¹, Georgiy Shcherbatyuk¹, Richard Inman¹, Dave Pelka², Weiya Zhang¹, Yvonne Rodriguez², Sue Carter², Roland Winston¹, Sayantani Ghosh¹; ¹Univ. of California at Merced, USA, ²Pelka & Associate Inc., USA, ³Univ. of California at Santa Cruz, USA. We show the optimum design of near infra-red emitting PbS quantum dots luminescent solar concentrators, and experimentally compare their performance with visible quantum dots and organic luminescent solar concentrators.

SWB4 • 11:50 a.m. **Invited**

Nanoarrays for Light Management in Thin Film Solar Cells, Jin Ji¹, Magued B. Nasr¹, Murray W. McCutcheon², Cy Herring³; ¹Lightwave Power, Inc., USA, ²Harvard Univ., USA, ³Sencera Intl., USA. We report the use of plasmonic and photonic nanoarray to achieve light management in thin film solar cells. Theoretical and experimental data will be presented.

12:30 p.m.–2:00 p.m. **Lunch Break** (on your own)

Sonoran II

Imaging Systems

2:00 p.m.–4:00 p.m.

IWC • 3-D Imaging

Matthew A. Kupinski; Univ. of Arizona, USA, President

IWC1 • 2:00 p.m. **Invited**

3-D Imaging Using Helical Point Spread Functions, Sean Quirin, Rafael Piestun; Univ. of Colorado at Boulder, USA. We engineer three-dimensional point spread functions to collect the information required for depth recovery and imaging. We investigate computational imaging systems using helical point spread functions for 3-D passive imaging and compare with prevailing methods.

IWC2 • 2:40 p.m.

Computational 3-D Fluorescence Microscopy Imaging, Amaradri Mukherjee, Chrysanthe Preza; Univ. of Memphis, USA. We show cell images from two different approaches of computational 3-D fluorescence imaging integrated on a single wide-field fluorescence microscope system and discuss advantages and disadvantages of the two techniques under investigation.

IWC3 • 3:00 p.m.

High-Resolution, Superfast 3-D Imaging Using a Phase-Shifting Method, Song Zhang¹, Yuanzheng Gong¹, Jacob Laughner², Qing Lou², Igor R. Efimov², Daniel van der Weide³; ¹Iowa State Univ., USA, ²Washington Univ., USA, ³Univ. of Wisconsin, USA. We present a system to realize 333 fps 3-D shape measurement speed at 768 X 768 resolution. It utilizes the DLP Discovery platform to realize 3-D shape measurement by using a defocusing method.

IWC4 • 3:20 p.m.

Depth Estimation with Locally Adaptive Support-Weight in a Thermographic Compound-Eye Camera, Keiichiro Kagawa, Yasuhiro Fujiwara, Jun Tamida; Osaka Univ., Japan. To obtain a smooth and edge-preserved depth from textureless thermal compound-eye image, combination of locally adaptive support-weight and joint bilateral filtering are proposed, which is demonstrated with a thermographic compound-eye camera with 3x3 aspherical lenses.

IWC5 • 3:40 p.m.

Robotic Surgery and the Opportunities for Advanced Imaging Modalities, Dave Scott; Intuitive Surgical, Inc., USA. Abstract not available.

Canyon I

Photonic Metamaterials and Plasmonics

2:00 p.m.–4:00 p.m.

MWC • Plasmonics V

Guy Bartal; Univ. of California at Berkeley, USA, President

MWC1 • 2:00 p.m. **Invited**

An Electrical Tuner to Command Optical Nanoantennas, Alexandre Bouhelier; Univ. de Bourgogne, France. Optical antennas are passive devices where fabrication designs decide operating frequency, gain and emission diagram. By introducing an electrically controllable load medium for the antenna, these characteristics can be externally controlled.

MWC2 • 2:40 p.m. **Invited**

Fundamental Investigations and Applications of Gold Nanoparticles Interacting with Their Immediate Nanoenvironment, Thomas Klar; Ilmenau Univ. of Technology, Germany. Gold nanoparticles interact strongly with their immediate nanoenvironment. They manipulate their surrounding as fluorescence quenchers or local heaters. In turn, they are influenced by their surrounding, by the refractive index or by chemical surface damping.

MWC3 • 3:20 p.m. **Invited**

Acousto-Plasmonic Hot Spots: Driving Enhanced Raman Scattering in Metallic Nanoparticles Javier Aizpurua¹, Nicolas Large^{1,2}, Lucien Savio³, Adnen Mlayah³; ¹Ctr. de Física de Materiales, CSIC, Spain, ²CNRS-Univ. de Toulouse, France, ³CNRS-Univ. de Bourgogne, France. We study theoretically and experimentally the coupling of acoustic vibrations (phonons) and surface plasmons in metallic nano-objects. The modulation of the surface charge density allows for the interpretation of experimental Raman-Brillouin spectra in silver nanorods.

Canyon III

Optics for Solar Energy

2:00 p.m.–4:00 p.m.

SWC • Device and Module Characterization

Georgios Veronis; Louisiana State Univ., USA, President

SWC1 • 2:00 p.m. **Invited**

Advanced Aspects of Indoor Characterization of CPV Modules, César Domínguez, Stephen Askins, Ignacio Antón, Gabriel Sala; Univ. Politécnica de Madrid, Spain. A comprehensive characterization process for concentrator PV modules is presented, based on a commercial solar simulator. Advanced aspects about irradiance and spectrum conditions monitoring are introduced. Recommendations of the forthcoming IEC norm are addressed.

SWC2 • 2:40 p.m.

Real Time Optical Monitoring of Properties of Silicon Thin Film Solar Panels, George Atanasoff; AccuStrata, Inc., USA. Optical monitoring of silicon absorbers is performed during deposition inside the chamber during solar panel manufacturing, providing adaptive control of film quality in real time. Practical results are discussed and the monitoring benefits are demonstrated.

SWC3 • 3:00 p.m.

Photovoltaic Cell Texture Quantitatively Relates to Efficiency, Nelson Blewett, Erik Novak; Veeco Metrology, Inc., USA. This paper describes a set of experiments which quantify the relationship between surface texture and photovoltaic cell efficiency using three-dimensional surface parameters calculated from white-light interferometric measurements.

SWC4 • 3:20 p.m. **Invited**

A Semi-analytical Model and Characterization Techniques for Concentrated Photovoltaic Multijunction Solar Cells, Yong-Hang Zhang, D. Ding, S. R. Johnson, S. H. Lim; Arizona State Univ., USA. A semi-analytical model for multijunction solar cells is established by extending the detailed balance model to include nonradiative recombination and other aspects of actual devices. Novel characterization techniques for multijunction solar cells are described.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits Open, Pavilion

Sonoran II

Imaging Systems

4:30 p.m.–6:10 p.m.

IWD • Projective Imaging

David Brady; Duke Univ., USA, *Presider*

IWD1 • 4:30 p.m. **Invited**

DARPA Imaging System Research, *Stuart Horn*; *Microsystems Technology Office (MTO), DARPA, USA*. Abstract not available.

IWD2 • 5:10 p.m.

Novel MEMS Deformable Mirror for Focus Control and Aberration Correction, *Brant M. Kaylor¹, Peter Roos¹, Jeffrey Lutzenberger¹, Jason R. Dahl², David L. Dickensheets³*; ¹*Bridger Photonics, Inc., USA*, ²*Spectrum Lab, Montana State Univ., USA*, ³*Dept. of Electrical and Computer Engineering, Montana State Univ., USA*. Electrostatically actuated MEMS mirrors for focus control have been fabricated. Deflection over 7.3 μm has been achieved using closed-loop control. Low-order aberrations were corrected and the devices were utilized in an imaging system.

IWD3 • 5:30 p.m. **Invited**

Compressive Imaging: Hybrid Projection Design, *Amit Ashok, Mark A. Neifeld*; *Univ. of Arizona, USA*. Compressive imaging/sensing employing a random measurement basis does not incorporate the specific object prior information available for natural images. An alternate hybrid measurement basis is proposed that yields improved reconstruction performance for natural images.

Canyon I

Photonic Metamaterials and Plasmonics

4:30 p.m.–6:30 p.m.

MWD • Toward 3-D Structures

Ekaterina Shamonina; *Univ. of Erlangen-Nuremberg, Germany, Presider*

MWD1 • 4:30 p.m.

Fabrication of Cubic Micron-Scale 3-D Metamaterial Resonators, *D. Bruce Burckel, Greg A. Ten Eyck, Joel R. Wendt, Igal Brener, Michael B. Sinclair*; *Sandia Natl. Labs, USA*. We present a new fabrication technique called Membrane Projection Lithography for the production of three-dimensional metamaterials at infrared wavelengths. Using this technique, multilayer infrared metamaterials that include both in-plane and out-of-plane resonators can be fabricated.

MWD2 • 4:50 p.m.

Infrared Cubic Dielectric Resonator Metamaterial, *James C. Ginn, Gregory A. Ten Eyck, Igal Brener, David W. Peters, Michael B. Sinclair*; *Sandia Natl. Labs, USA*. Dielectric resonators are an effective means to realize isotropic, low-loss optical metamaterials. As proof of this concept, a cubic resonator is analytically designed and then tested in the long-wave infrared.

MWD3 • 5:10 p.m.

3-D Optical Yagi-uda Nanoantenna Array, *Daniel Dregely, Richard Taubert, Harald Giessen*; *Univ. of Stuttgart, Germany*. We fabricated three-dimensional arrays of optical Yagi-Uda nano-antennas. Due to the high directivity of the array structure the incoming light is received efficiently at the resonant wavelength in the near-infrared (around $\lambda = 1.3$ micrometers).

MWD4 • 5:30 p.m.

Mid-Infrared Amplitude and Phase Measurement of Metamaterials Using Tandem Interferometry, *Brandon S. Passmore, John Anderson, Greg A. Ten Eyck, Joel R. Wendt, Igal Brener, Michael B. Sinclair, Eric A. Shaner*; *Sandia Natl. Labs, USA*. A tandem interferometer system measuring the absolute phase and amplitude of planar split-ring resonators fabricated on a BaF₂ substrate with a designed resonance at 10.5 μm is presented.

MWD5 • 5:50 p.m. **Invited**

Direct Probing of the Magnetic Field of Light at Optical Frequencies, *Kobus Kuipers*; *FOM Inst. for Atomic and Molecular Physics (AMOLF), Netherlands*. Nanostructures can greatly affect the subwavelength structure of light fields. We map those vector fields, observe polarization singularities in the electric fields and, for the first time, visualize the magnetic component of light.

Canyon III

Optics for Solar Energy

4:30 p.m.–6:30 p.m.

SWD • Organic and Thin Film PV

Jin Ji; *Lightwave Power, Inc., USA, Presider*

SWD1 • 4:30 p.m. **Invited**

Nanoarchitected Polymers and Polymer Nanocomposites for Photovoltaic Applications, *Robert Norwood*; *Univ. of Arizona, USA*. Abstract not available.

SWD2 • 5:10 p.m.

Commercial CIGS Solar Cells for Concentrator Applications, *Deming Zhang¹, Jose M. Castro¹, Raymond K. Kostuk^{1,2}*; ¹*Dept. of Electrical and Computer Engineering, Univ. of Arizona, USA*, ²*College of Optical Sciences, Univ. of Arizona, USA*. We studied the effect of concentration on commercial CIGS solar cells. Measurement results indicate 23% improvement in efficiency can be achieved under 20X. Methods to optimize concentrator cells for higher irradiance levels are also discussed.

SWD3 • 5:30 p.m.

Evaluation of the Quality Factor of Microcrystalline Thin-Film Solar Cell, *Sheng-Hui Chen¹, Ting-Wei Chang¹, Yi-Chan Chen², Yu-Hung Chen²*; ¹*Dept. of Optics and Photonics, Taiwan*, ²*Photovoltaics Technology Ctr., Taiwan*. By dividing the absorption coefficient at 1.4eV with the value at 0.9eV, we could judge the quality of $\mu\text{-Si:H}$ and predict ($V_{oc}^* I_{sc}$) of solar cell when using this layer as its intrinsic layer.

SWD4 • 5:50 p.m.

Novel Organic Solar Cell Design towards an Optical Control of the Exciton Diffusion Length, *Jordi Martorell, Xavier Elias, Saverio Pasini, Rafael Betancur, Luat T. Vuong, Roberto Macovez*; *ICFO, Spain*. The exciton diffusion could be increased if highly fluorescent materials were used. We developed a kind of such material and studied the performance of solar cells where the electrodes form a cavity for fluorescence control.

SWD5 • 6:10 p.m.

Detailed Balance Solar Cell Efficiency Limits for Internal Fluorescence Yield Slightly Less than 100%, *Owen D. Miller, Eli Yablonovitch*; *Univ. of California at Berkeley, USA*. The Shockley-Queisser approach to calculating solar cell efficiencies assumes 100% internal fluorescence yield. This is misleading, as even a slight drop in internal yield to 90% already causes a severe drop below the Shockley-Queisser limit.

Key to Authors and Presiders

(**Bold** denotes Presider or Presenting Author)

Aeschlimann, Martin-**MTuC1**, **MWB**
Aggarwal, Ishwar-**IMB5**
Aguilar, Juan A.-**STuE6**
Aguilera, Sara-**STuE6**, **STuE9**
Airado-Rodríguez, Diego-**ATuC2**
Aizpurua, Javier-**MWC3**
Akimov, Yuriy-**SWA3**
Aleksyev, L.-**MTuA4**
Alici, Kamil Boratay-**JTuA12**
Alvarez, Roberto-**SMA2**
Ameling, Ralf-**MTuC4**
Anderson, Gail P.-**OMA3**
Anderson, John-**MWD4**
Andryeusk, Andrei-**MWB2**
Angel, Roger-**STuD1**
Anna, Guillaume-**JTuA25**
Annen, Hans Philipp-**STuD4**
Antón, Ignacio-**STuA4**, **STuC4**, **SWC1**
Antonini, Andrea-**STuA1**
Arias, Larry-**AMB3**
Arnone, Robert-**OMB1**
Ashok, Amit-**IMC4**, **IWD3**
Askins, Stephen-**STuA4**, **SWC1**
Aspnes, Eric D.-**STuB5**, **STuD3**
Atanasoff, George-**SWC2**
Atwater, Harry A.-**MMD4**
Ayala, Alejandro P.-**JTuA10**
Azad, Abul K.-**MMC4**

Babbitt, Wm. R.-**AMA3**
Bachelier, Guillaume-**MTuB4**
Bachmann, Charles M.-**JTuA28**, **JTuA33**, **OMD**, **OMD2**
Baena Gallé, Roberto-**DMD3**
Baer, Rick-**ITuB3**
Bai, Ping-**JTuA4**
Bakic, Predrag-**DTuA3**
Baldwin, Leo-**SMB4**
Barber, Zeb W.-**AMA3**
Barbosa-García, Oracio-**AMC3**, **ATuC5**
Baricordi, Stefano-**STuA3**
Barnakov, Yu. A.-**MTuA4**
Barnett, Allen-**SWA**, **SWB1**
Bartal, Guy-**MWA2**, **MWC**
Bartoli, Filbert-**JTuA2**, **JTuA9**, **MMD1**
Bauer, Michael-**MTuC1**
Bayer, Daniela-**MTuC1**
Bayya, Shyam-**IMB5**
Belhadj Tahar, Jamel-**JTuA21**
Bell, Jr., Raymond M.-**OMA1**
Benichou, Emmanuel-**MTuB4**
Benitez, Pablo-**SMA2**
Bennett, Gisele-**IMB3**, **IMC**, **IWB1**
Berg, Trenton J.-**AMA3**, **OMC3**
Berkner, Kathrin-**DMB3**
Betancur, Rafael-**SWD4**
Bewley, William W.-**MMC1**
Bhakta, Vikrant R.-**DMD1**
Blair, John-**MWB6**
Blewett, Nelson-**SWC3**
Bloomstein, Theodore M.-**MMB3**
Boltasseva, Alexandra E.-**MTuA3**
Bommareddi, Rami Reddy-**AMA2**
Bondy, Dan-**JTuA29**
Bonnet, Aurelie-**JTuA25**
Boreman, Glenn D.-**ITuA1**, **ITuB**, **JTuA1**
Borneman, Joshua D.-**MMA3**
Bossard, Jeremy A.-**MWB3**
Bouhelier, Alexandre-**MWC1**
Boutami, Salim-**JTuA18**
Bovik, Alan C.-**DMA1**, **DTuA**
Brady, David J.-**ATuA2**, **ITuC2**, **IWD**
Brayer, David-**JTuA3**
Brener, Igal-**MWD1**, **MWD2**, **MWD4**
Brevet, Pierre-François-**MTuB4**
Brixner, Tobias-**MTuC1**

Bryant, Kyle-**IMB3**
Buchwald, Walter R.-**JTuA1**
Buckley, Steven G.-**AMC1**
Budak, Vladimir P.-**OMD4**
Bukhari, Syed Qasim-**JTuA27**
Buljan, Marina-**SMA2**
Burckel, D. B.-**MWD1**
Busnaina, Ahmed-**MMB3**
Bussmann, Konrad-**MMC1**
Bustin, Nick-**IMD1**
Butet, Jérémy-**MTuB4**

Cabrera, Sergio D.-**DTuB2**
Calder, Brian R.-**OMC4**, **OMC5**
Carminati, Rémi-**JTuA3**
Carter, Sue-**SWB3**
Castañeda, Román-**DMD2**
Castillo Aguilera, Jose E.-**STuB2**
Castillo, Jose E.-**STuB4**, **STuB5**, **STuD3**
Castro, Jose M.-**STuB3**, **SWD2**
Catrysse, Peter B.-**IMD**, **ITuA3**, **JTuA26**
Cayron, Cyril-**JTuA18**
Cha, Jae-**IWA4**
Chakrabarti, Sangeeta-**JTuA17**
Chang, Ting-Wei-**SWD3**
Chang, Ying-Yu-**JTuA22**
Chanover, Nancy-**ATuA5**
Chapman, Ken-**ATuA2**
Chaves, Julio-**SMA2**
Chellappa, Rama-**DMC2**
Chen, Frank F.-**MMC4**
Chen, Hou-Tong-**MMC4**
Chen, Kuo-Ping-**MMA3**
Chen, Sheng-Hui-**SWD3**
Chen, Yi-Chan-**SWD3**
Chen, Yi-Ping-**JTuA22**
Chen, Yu-Hung-**SWD3**
Cheng, Hsin-Hung-**JTuA22**
Choi, Joonhee-**MMA2**
Choubani, Fethi-**JTuA21**
Christensen, Eric-**SWB2**
Christensen, Marc P.-**DMD1**
Christian, Sean M.-**AMC**, **ATuA**
Chu, Hong-Son-**JTuA4**, **SWA3**
Chu, Jen-You-**JTuA22**
Cipar, John-**OMB**, **OTuA**, **OTuB1**
Cleary, Justin W.-**JTuA1**
Clements, Jake-**OTuB5**
Contreras, Ulises-**AMC3**
Cook, Monica-**JTuA29**
Cooley, Thomas W.-**OMA2**, **OMA3**, **OTuB1**
Corson, Michael R.-**OMA4**, **OMB1**
Craparo, Joseph-**AMC4**
Crawford, Melba-**OMA**
Cull, Evan-**ATuA2**
Cunovic, Stefan-**MTuC1**
Cvetkovic, Aleksandra-**SMA2**

da Costa, José A. P.-**JTuA10**
da Silva, Rizia R.-**JTuA10**
Dahl, Jason R.-**IWD2**
Danielson, David-**SMA1**
Daughtry, Craig-**OTuA1**
Davis, Curt O.-**OMB1**
Davis, Curtiss O.-**OMA4**
De Pauw, Eddy-**JTuA30**
De Saro, Robert-**AMC4**
Defernez, A.-**ITuA2**
Demenikov, Mads-**IMD1**
Dhar, Nibir-**IMB1**
Di Fabrizio, Enzo-**MTuB3**
Diaz, Frédéric-**IMD4**
Dickensheets, David L.-**IWD2**
Dierckx, Bart-**ITuA2**
Dierolf, Volkmar-**JTuA2**

Dillon, Keith J.-**IWA3**
Dilmanian, Avraham-**DTuB4**
Dimler, Frank-**MTuC1**
Ding, Ding-**STuE7**, **SWC4**
Dion, Denis-**IWA5**
Dominguez, César-**STuA4**, **STuC4**, **SWB**, **SWC1**
Doody, Colin-**OTuB5**
Doraiswamy, P. C.-**OTuA2**
Drachev, Vladimir P.-**MMA3**
Draper, Russell S.-**IMB3**
Dregely, Daniel-**MWD3**
Driggers, Ronald-**IMA**, **IWB1**
Duboisset, Julien-**MTuB4**
Dudley, Richard-**ATuC3**
Dumelow, Thomas-**JTuA10**
Duncan, Michael D.-**JTuA33**
Dupont, Benoit-**ITuA2**
Durach, Maxim-**MMD5**, **MTuC5**

Echegoyen, Yolanda-**MMB3**
Edelmann, André G.-**JTuA13**, **JTuA6**
Efimov, Igor R.-**IWC3**
Eichenholz, Jason M.-**ATuA4**, **ATuB2**
Eismann, Michael-**ITuC1**
Elias, Xavier-**SWD4**
Espinola, Richard L.-**IWA4**

Fahr, Stephan-**SWA4**
Fainman, Yeshaiahu-**IWA3**
Fan, Shanhui-**MTuA2**, **SWA2**
Fang, Nicholas X.-**MMA4**, **MMC5**, **MTuC**
Farrell, Joyce-**IWB**, **JTuA26**
Feigenbaum, Eyal-**MMD4**
Felde, Gerald W.-**OMA3**
Fernandez-Cull, Christiany-**IMB4**
Fesenmaier, Christian C.-**ITuA3**
Fienup, James R.-**IMD2**
Fischer, Alexander-**MTuC1**
Fismen, Britta G.-**ATuB3**, **ATuC2**
Fleet, Erin-**IMB5**
Flynn, Richard A.-**MMC1**
Forand, Luc-**IWA5**
Ford, Jess-**AMA**, **ATuC**
Ford, Joseph E.-**IMC2**, **STuA**, **STuD2**
Fowler, Boyd-**ITuA**, **ITuB2**
Freal, James-**ATuB1**
Freeman, William-**DMC1**
Froufe-Pérez, Luis S.-**JTuA3**
Fry, John C.-**JTuA28**, **JTuA33**, **OMD2**
Fu, Ling-**STuD4**
Fuentes, Sandra-**STuE6**, **STuE9**
Fujiwara, Yasuhiro-**IWC4**
Fusina, Robert A.-**JTuA28**, **OMD2**

Gabitov, Ildar-**JTuA15**
Gan, Qiaoqiang-**JTuA2**, **JTuA9**, **MMD1**
Gao, Yongkang-**JTuA9**, **MMD1**
Gamsi, Taieb-**JTuA32**
Gehm, Michael E.-**IMB2**
Genov, Dentsho A.-**JTuA11**
George, Mark-**STuC1**
Ghadarghadr, Shabnam-**JTuA16**
Gharibyan, Armen S.-**STuE11**
Ghosh, Sayantani-**SWB3**
Gibson, Tolanya-**JTuA15**
Giessen, Harald-**MMB4**, **MTuA**, **MTuC4**, **MWD3**
Ginn, James C.-**MWD2**
Gjessing, Jo-**STuC2**
Gladysz, Szymon-**DMD3**
Glenar, David-**ATuA5**
Goh, Wei Peng-**SWA3**
Gombert, Andreas-**SMB1**
Gong, Yuanzheng-**IWC3**
Gorman, Alistair-**OMB2**
Goudail, François-**IMD4**

- Gould, Richard-OMB1
 Gray, Deric-OMD2
 Guenther, Brett-ATuA2
 Guleryuz, Onur-DMB2
 Guo, Junpeng-MWB4
 Guzmán, M.-STuE6
- Hagan, David J.-MMA3
 Haitao, Dai-JTuA14
 Hamoir, Dominique-JTuA25
 Hao, Qingzhen-JTuA8
 Haque, Fozia Z.-STuE5
 Harada, Yushi-DMA3
 Harvey, Andrew R.-IMD1, OMB2
 Hasler, Ian-IMD1
 Hastings, Art-IMB3
 Hecht, Bert-MMD3
 Helfert, Stefan F.-JTuA13, JTuA6
 Henckes, P.-JTuA2
 Herr-Cardillo, Starr-STuB4
 Herring, Cy-SWB4
 Hespel, Laurent-JTuA25
 Hess, Ortwin-MWA4
 Hirakawa, Keigo-DMC4
 Hofer, Wolfgang J. Reinhard.-JTuA4
 Honorato, Sara B.-JTuA10
 Hor, Yew Li-JTuA19
 Horn, Stuart-IWD1
 Horstmeyer, Roarke W.-IMD3
 Hu, Chung An-STuE10
 Huang, Tony Jun-JTuA8
 Hughes, Roy-OMD3
 Huignard, Jean-Pierre-IMD4
 Hunt, Jr., E. R.-OTuA2
 Huo, Qingkai-DTuB4
 Huo, Yijie-ITuA3
 Husain, Mushahid-STuE5
- Iftekharuddin, Khan-DMC3, DTuB
 Iliw, Rumen-MWB2
 Inman, Richard-SWB3
 Ito, Satoshi-DMA3
- Jackson, Carl-AMA4
 Jacob, Zubin-MTuA3, MTuA4
 Jaeger, Klaus-STuC3
 Jahns, Jürgen-JTuA13, JTuA6
 James, Jonathan C.-IMB3
 Jang, Tae Seong-OMB3
 Jensen, Lasse-JTuA8
 Jha, Abhinav K.-DTuB3
 Ji, Jin-SWB4, SWD
 Jing, Enjie-OMD3
 Johnson, Ken-ATuC1
 Johnson, S. R.-SWC4
 Jonin, Christian-MTuB4
 Joseph, James-AMC2
 Joshi, Saamil-MWB1
 Juluri, Bala Krishna-JTuA8
- Kagawa, Keiichiro-IWC4
 Kamma, Indumathi-AMA2
 Kang, Kyung In-OMB3
 Karp, Jason H.-STuE2
 Kaylor, Brant M.-AMA3, IWD2
 Ke, Jun-DMB3
 Kean, Alistair-JTuA18
 Kerekes, John P.-DMA2
 Khurgin, Jacob B.-JTuA7, MTuB1, MTuB2
 Kildishev, Alexander V.-MMA3
 Kim, Chulsoo-MMC1
 Kim, Ji-Young-MTuA3
 Kim, Seungchul-MMA2
 Kim, Seung-Woo-MMA2
 Kim, Woohong-IMB5
 Kirby, Edmund I.-MWA4
 Kirkhus, Trine-ATuB3
 Kirmani, Ahmed-IMC3
 Kishima, Koichiro-AMB2
 Kivalov, Sergey N.-SMB2
 Klar, Thomas-MWC2
- Kneipp, Harald-MMB1
 Kneipp, Katrin-MMB1, MMC
 Kofke, Matthew J.-MTuC3
 Koh, Wee Shing-SWA3
 Korkin, Sergey V.-OMD4
 Korwan, Daniel-OMD2
 Koshel, R. John-STuB
 Kost, Alan R.-SMA, STuE3
 Kostuk, Raymond K.-SMB, STuB3, SWD2
 Krapels, Keith-IMA1
 Krenz, Peter M.-ITuA1
 Kriss, Michael-ITuC
 Kuipers, Kobus-MWD5
 Kumar, Amaresh M. V.-OMC4
 Kumar, Anil-MTuB5
 Kumar, Rakesh-STuB4
 Kupinski, Matthew A.-DTuB3, IWC
- Labidi, Mondher-JTuA21
 Lail, Brian A.-ITuA1
 Lanher, Bertrand-ATuB, ATuC4
 Large, Nicolas-MWC3
 Laughner, Jacob-IWC3
 Lavrinenko, Andrei V.-MWB2
 Lederer, Falk-JTuA5, MWB2, SWA4
 Lee, Jun Ho-OMB3
 Lee, Jung-Yong-SWA2
 Lee, Krista-JTuA28, OMD2
 Leist, Jon-ATuC3
 Leong, Hai S.-MWB4
 Leutz, Ralf-STuE4
 Leyton, Patricio-STuE9
 Lezec, Henri-MTuC2
 Li, Er-Ping-JTuA4
 Li, H.-MTuA4
 Li, Jennifer-SWA2
 Li, Jia-Han-JTuA22
 Li, Jing-Jing-STuE7
 Li, Rong-Rong-JTuA28, OMD2
 Li, Rongxing-OTuA1
 Li, Yuning-SWA3
 Liberman, Vladimir-MMB3
 Lim, Swee Hoe-STuE7, STuE8, SWC4
 Lin, Ding-Zheng-JTuA22
 Linden, Stefan-MMC2
 Lindle, J R.-MMC1
 Litchinitser, Natalia-JTuA15
 Lithgow, Gregg A.-AMC1
 Liu, Katherine X.-STuE3
 Liu, Na-MMB4
 Liu, Zhaowei-MWB5
 Loiseaux, Brigitte-IMD4
 Long, James P.-MMC1
 Lonigro, Lucien-ATuA1
 López-de-Alba, Pedro L.-AMC3
 López-Martínez, Leticia-AMC3
 Lou, Qing-IWC3
 Lucke, Robert L.-OMA4
 Lutzenberger, Jeffrey-IWD2
 Lyapustin, Alexei I.-OMD4
- M.Patel, Vishal-DMC2
 Ma, Changbao-MWB5
 Ma, Hyungjin-MMA4
 MacDonough, Julia L.-JTuA29
 Macovez, Roberto-SWD4
 Madanipour, Khosro-JTuA34, JTuA35, JTuA36
 Mait, Joseph N.-IMB4
 Maldonado, Jose L.-ATuC5
 Malureanu, Radu-MWB2
 Marks, Daniel L.-ITuC2
 Marstein, Erik S.-STuC2
 Martín, Rebeca Herrero-STuA4
 Martin, Suzanne-OTuB3
 Martinelli, Giuliano-STuA1, STuA3
 Martorell, Jordi-SWD4
 Mayer, Theresa S.-MWB3
 Mayy, M.-MTuA4
 McConnon, Cecilia-OMD2
 McCutcheon, Murray W.-SWB4
 McPherson, Christopher-OMC1
- Meentemeyer, Ross K.-OMC2
 Mendoza, Edgar A.-AMA1
 Meneses-Nava, Marco A.-AMC3, ATuC5
 Meng, Qingmin-OMC2
 Menzel, Christoph-MWB2
 Mesch, Martin-MMB4
 Meyer, Jerry R.-MMC1
 Meza, Pablo-JTuA24
 Miller, Andrew-IMB5
 Miller, Owen D.-SWA1, SWD5
 Miller, Timothy N.-OMA1
 Min, Changjun-MMD2, SWA2
 Miñano, Juan Carlos-SMA2, STuB
 Mintova, Svetlana-OTuB3
 Miroztnik, Mark S.-IMB4
 Mlayah, Adnen-MWC3
 Mohammadi, Fateme-JTuA35
 Mohedano, Rubén-SMA2
 Montes, Marcos J.-JTuA28, OMB1, OMD1, OMD2, OTuB
 Moore, Duncan-SWB2
 Mosallaei, Hossein-JTuA16
 Mozjerin, Irene-JTuA15
 Muffato, Viviane-JTuA18
 Mühlhig, Stefan-JTuA5
 Mukherjee, Amaradri-IWC2
 Muyo, Gonzalo D.-IMD1, OMB2
 Myers, Kyle J.-DTuA3
 Myneni, Vimeetha-DTuA2
- Naftaly, Mira-ATuC3
 Naik, Gururak V.-MTuA3
 Najjar, Rita-JTuA18
 Nakamura, Shunsuke-DTuB4
 Nampoori, V. P. N.-DMD7
 Narimanov, Evgenii-MTuA3, MTuA4
 Nasr, Magued B.-SWB4
 Naydenova, Izabela G.-OTuB3
 Nayegandhi, Amar-OTuA3
 Neifeld, Mark A.-IMC4, IWD3
 Ni, Jie-DMC2
 Nichols, C. Reid-JTuA28, JTuA33, OMD2
 Noginov, Mikhail A.-MTuA4, MWA
 Norwood, Robert-MMA3, SWD1
 Novak, Erik-SWC3
- O'Farrell, Marion-ATuB3
 O'Brien, Kevin-STuE8
 Occhiali, Massimiliano-STuA3
 O'Farrell, Marion-ATuA3, ATuC2
 Oh, Se Baek-IMD3
 O'Hara, John F.-MMC4
 Okuno, Yoichi-JTuA23
 Oladeji, Isaiah-JTuA1
 Olmon, Robert-ITuA1
 Orchard, Michael T.-DMB
 Ornelas-Soto, Nancy-AMC3, ATuC5
 O'Sullivan, Joseph-DTuB1
 Ottestad, Silje-ATuA3
 Oulton, R. F.-MWA2
 Ozbay, Ekmel-JTuA12
- Pacifici, Domenico-MTuC2
 Padilha, Lazaro A.-MMA3
 Padula, Francis-JTuA29
 Palomero, Cherry May-DMD5
 Pandharkar, Rohit-IMC3
 Park, In-Yong-MMA2
 Park, Subok-DTuA3
 Park, Won-MWB1, MWB6
 Parks, Robert-STuA2
 Parretta, Antonio-STuA1, STuA3, STuE1, STuE2
 Parrish, Christopher E.-JTuA28, OMC, OMC5, OMD2
 Pasini, Saverio-SWD4
 Passmore, Brandon S.-MWD4
 Paul, Thomas-MWB2
 Pawluczyk, Romauld-AMC4
 Peèri, Shachak-OMC4, OMC5
 Peale, Robert E.-JTuA1
 Pelka, Dave-SWB3
 Pennybacker, Matthew-JTuA15

- Perez, Richard–SMB2
 Peters, David W.–MWD2
 Peumans, Peter–ITuB1, SWA2
 Peyghambarian, N.–MMA3
 Pfeiffer, Walter–MTuC1
 Phani, Arindam–AMB1
 Pichardo-Molina, Juan L.–ATuC5
 Piestun, Rafael–DTuA1, IWC1
 Pniewski, Jacek–JTua5
 Polizzi, Dominick–AMB
 Popescu, Sorin–OMB4
 Potuluri, Prasant–ATuA2
 Potunuru, Venkata S.–DTuB2
 Potvin, Guy–IWA5
 Pratt, William–DMD
 Preza, Chrysanthe–DTuA2, IWC2
 Privato, C.–STuA1
- Qi, Yuting–ATuA2
 Qian, Charles–STuE3
 Qian, Wei–DTuB2
 Quesnel, Etienne–JTua18
 Quirin, Sean–IWC1
- Ramakrishna, S. Anantha–JTua17
 Raman, Aaswath–MTuA2
 Ramos-Ortiz, Gabriel–ATuC5
 Raschke, Markus–ITuA1
 Raskar, Ramesh–IMC3, IWA2, IWB2
 Ravi, Vinay–AMC2
 Reagan, John–OMC1
 Reago, Don–IMA2, IMB
 Reddy, Dikpal–IWA2
 Reeves III, J. B.–OTuA2
 Reibel, Randy R.–AMA3
 Restrepo-Martinez, Alejandro–DMD2
 Reynolds, Robert K.–DMC3
 Rezaie, Amir Hossein–JTua35
 Rhee, Seung-Wu–OMB3
 Rivas-Perea, Pablo–DMD4
 Riviere, Nicolas–JTua25
 Robinson, Dirk–DMB3
 Rockstuhl, Carsten–JTua5, MWB2, SWA4
 Rodriguez, Jeffrey J.–DTuB3
 Rodriguez, Yvonne–SWB3
 Rohmer, Martin–MTuC1
 Romero, Carlos–AMC4
 Roncati, Dario–STuE1, STuE2
 Roos, Peter–IWD2
 Roos, Peter A.–AMA3, OMC3
 Rosenberg, Glenn–STuB2, STuB4, STuB5, STuD3
 Rosiles, Jose G.–DMD4
 Rothschild, Mordechai–MMB3
 Rusina, Anastasia–MMD5, MTuC5
 Russier-Antoine, Isabelle–MTuB4
 Russo, Juan M.–STuB2, STuB4, STuB5, STuD3
 Ruther, Matthias–MMC2
 Rzhanov, Yuri–OMC5
- Sachs, Todd–IWA
 Sala, G.–STuA4, STuC4
 Sala, Gabriel–SWC1
 Salimi Meidaneshahi, Fatemeh–JTua36
 Samala, Ravi K.–DTuB2
 Sanghera, Jasbinder–IMB5
 Santbergen, Rudi–JTua18
 Saranu, Srinivas–JTua18
 Saviot, Lucien–MWC3
 Schaum, Alan–DMB4
 Schmidt, Greg–SWB2
 Schneider, Christian–MTuC1
 Schott, John–OTuB5
 Schulerud, Helene–ATuA3
 Schurig, David–IMC1
 Scott, Dave–IWC5
 Sellars, Jon–JTua28, OMD2
 Serbin, Guy–OTuA2
 Seyfarth, Alexander–AMB3
- Shalae, Vladimir M.–JTua15, MMA3, MTuA3
 Shamonina, Ekaterina–MTuA1, MWD
 Shaner, Eric A.–MWD4
 Shao, Lihua–MMC2
 Shastri, Lokesh–STuE5
 Shaw, Brandon–IMB5
 Shcherbatyuk, Georgiy–SWB3
 Shepard, Scott–SMB3, STuE4
 Sheridan, John–IWA1
 Shokri, Babak–JTua36
 Simoncelli, Eero–DMB1, DMC
 Simovski, Constantine–JTua5
 Sinclair, Michael B.–MWD1, MWD2, MWD4
 Singh, Kunwar K.–OMC2
 Slack, Thomas B.–DMC3
 Soh, Mui Siang–SWA3
 Somayaji, Manjunath–DMD1
 Somu, Sivasubramanian–MMB3
 Soref, Richard–JTua1
 Sorger, V. J.–MWA2
 Soriano, Maricor–DMD5
 Steeb, Felix–MTuC1
 Steenbergen, Elizabeth H.–STuE8
 Stefancich, Marco–STuA3
 Stenner, Michael D.–IMB2
 Stephen, Renu M.–DTuB3
 Stevens, James–IMB3
 Stipe, Christopher B.–AMC1
 Stockman, Mark I.–MMB, MMD5, MTuC5
 Stopeck, Alison T.–DTuB3
 Stork, David G.–DMA, DMB3
 Strüber, Christian–MTuC1
 Sudbø, Aasmund–STuE2
 Summers, Christopher–MWB6
 Sun Woh, Lye–AMC2
 Sun, Greg–JTua7, MTuB1, MTuB2
 Sun, X. W.–JTua14
 Sundaram, Ramakrishnan–DMC5
 Suyama, Taikei–JTua23
 Swayze, Gregg–OTuB2
 Symko-Davies, Martha–STuC
- Tajdini, Mohammad M.–JTua16
 Takeda, Tohoru–DTuB4
 Tamma, Venkata A.–MWB1, MWB6
 Tang, Yan–MWB3
 Tanida, Jun–IWC4
 Taubert, Richard–MWD3
 Tavassoly, Mohammad Taghi–JTua34
 Tawalbeh, Rula M.–ATuA5
 Taylor, Antoinette J.–MMC4
 Ten Eyck, Gregory A.–MWD1, MWD2, MWD4
 Teshebaeva, Kanayim O.–JTua31
 Toal, Vincent–OTuB3
 Torres, Sergio–JTua24
 Townsend, Daniel J.–IMB2
 Treeaporn, Vicha–IMC4
 Tremblay, Eric J.–IMC2, STuD2
 Tsakmakidis, Kosmas L.–MWA4
 Tschudi, Jon–ATuA3, ATuB3, ATuC2
 Tumkur, T. U.–MTuA4
 Turaga, Pavan–DMC2
- Unger, Blair–SWB2
 Urcid-S., Gonzalo–DMD6
- Vadakke Matham, Murukeshan–AMC2
 Vaishakh, Manu–DMD7
 Valdiviezo-Navarro, Juan C.–DMD6
 van der Weide, Daniel–IWC3
 Van Duyn, Richard–MMB2, MTuB
 Van Stryland, Eric W.–MMA3
 Vandenberg, Cédric–JTua3
 Vaughan, R. Brandon–IMB3
 Veeraraghavan, Ashok–IWA2
 Velluet, Marie Therese–JTua25
 Vera, Esteban–JTua24
 Veronis, Georgios–MMD2, SWA2, SWC
- Verslegers, Lieven–ITuA3
 Vettenburg, Tom–IMD1
 Victoria, Marta–STuC4
 Villarroel, Roberto–STuE9
 Vincenzi, Donato–STuA1, STuA3
 Voelz, David–ATuA5
 Vogler, John B.–OMC2
 Voronine, Dmitri V.–MTuC1
 Vuong, Luat T.–SWD4
 Vurgafman, Igor–MMC1
- Waldeck, David H.–MTuC3
 Walli, Karl–OTuB5
 Wanare, Harshwardhan–JTua17
 Wandell, Brian–JTua26
 Wang, Chunhua–SWB3
 Wang, Xiaoting–SWB1
 Waterman, James–IMA3
 Watson, Arthur–ATuB4
 Webster, Scott–MMA3
 Wegener, Martin–MMA, MMC2
 Weiner, John–MTuC2
 Weisberg, Arel–AMC4
 Weiss, Thomas–MMB4
 Weissmueller, Joerg–MMC2
 Wende, Jon–OMD2
 Wendt, Joel R.–MWD1, MWD4
 Werner, Douglas H.–MWB3
 White, Stephen A.–OMC5, OMD2
 Whitehouse, Andrew I.–AMC4
 Wikner, David A.–IMB4
 Winston, Roland–SWB3
 Wold, Jens Petter–ATuA3, ATuC2
 Wood, Andy–IMD1
 Wood, Jack W.–IMB3
 Woolard, Jason–OMD2
 Wu, Weicheng–JTua30
- Xiao, Xifeng–ATuA5
 Xu, Jun–MMA4
 Yablonovitch, Eli–SWA1, SWD5
- Yamada, Yoshifumi–DMA3
 Yamnitskiy, Konstantin–MMA3
 Yang, S. L.–STuE10
 Yang, T. J.–STuE10
 Yilmaz, Cihan–MMB3
 Young, Stefano–DTuA3
 Yuasa, Tetsuya–DTuB4
 Yun, Seokho–MWB3
- Zamora, Pablo–SMA2
 Zampierolo, Letizia–STuE1
 Zarate, Ramon A.–STuE6, STuE9
 Zeman, Miro–STuC3
 Zentgraf, T.–MWA2
 Zhang, Boyang–MWB4
 Zhang, Deming–STuB3, SWD2
 Zhang, Jianying–DTuB2
 Zhang, Shuang–JTua11
 Zhang, Song–IWC3
 Zhang, Ting-Ting–OTuB4
 Zhang, Weiya–SWB3
 Zhang, Xiang–JTua11, MWA2
 Zhang, Yaoju–JTua23
 Zhang, Yong-Hang–STuE7, STuE8, SWC4
 Zheludev, Nikolay–MMA1, MMD
 Zheng, Yue Bing–JTua8
 Zhou, Jiangfeng–MMC4
 Zhou, Liangcheng–JTua2
 Zhu, G.–MTuA4
 Zhu, Lin–MMD1
 Ziolkowski, Richard–MWA1
 Zou, Yi–MWB4
 Zybovich, Alexander–JTua31

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Withdrawals:

DMA3 DMD3
JTua12 MTua1
SWB3

Presider Updates:

MWD will be presided over by *Martin Wegener; Karlsruhe Inst. of Technology. Univ. of Karlsruhe, Germany*

DMD will be presided over by *Khan Iftekharuddin; Univ. of Memphis, USA.*

DTua will be presided over by *Chrysanthe Preza; Univ. of Memphis, USA*

The presider for **STuC** will be announced on-site.

Presenter Updates:

IMB4 will be presented by *David Brady; Duke Univ., USA*

SMB1 will be presented by *Chantal Arena; SOITEC, France*

STua1 will be presented by *Marco Stefancich; MIT, USA*

PDOTua2 will be presented by *Johannes Koeth; nanoplus Nanosystems and Technologies GmbH, Germany*

Presentation Time Updates:

OMA1 will be presented in two parts. The first part will be on Monday from 8:00 a.m.–8:20 a.m. The second part will be from 5:30 p.m.–5:50 p.m.

OMD2 will be presented from 4:50 p.m.–5:30 p.m.

OMD3 will be presented from 5:30 p.m.–5:50 p.m.

OMD4 will be presented from 5:50 p.m.–6:10 p.m.

MTua2 will be presented from 9:20 a.m.–9:40 a.m. on Wednesday, June 9 in session **MWA**

Session Updates:

STuB will now start at 10:50 a.m.

ITuC will now end at 5:50 p.m.

PDOTua will now end at 5:50 p.m.

Title Update:

The title for **MTuB5** should read **Cathodoluminescence Imaging of Plasmonic Modes of Ag Nanostructures**

Abstract Update:

The abstract for **IWB1** should read Super-resolution is known to be a number of different processes. One is enhancing the resolution beyond the diffraction limit of an imaging system and another is enhancing the resolution beyond the sampling limits of an imaging system. These two processes will be discussed and described with application to appropriate military imaging systems.

Committee Member Update:

The affiliation for Bertrand S. Lanher is now Process Analytical Chemistry Services, USA

Imaging and Applied Optics Congress 2010

Applied Industrial Optics: Spectroscopy, Imaging
and Metrology (AIO)
Digital Image Processing and Analysis (DIPA)
Imaging Systems (IS)
Photonic Metamaterials and Plasmonics (META)
Optical Remote Sensing of the Environment (ORS)
Optics for Solar Energy (SOLAR)

Tucson, Arizona



June 7-9, 2010

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Imaging Systems (IS) Abstracts

•Tuesday, June 8, 2010•

JTuA • Joint AIO/IS/META/ORS Poster Session

Pavilion

2:00 p.m.–4:00 p.m.

PDJTua1

Variation of Optical Constants of $\text{Se}_{85-x}\text{Te}_{15}\text{In}_x$ Glass

System, *D. Sushama*^{1,2}, *Ginjala R. C. Reddy*¹, *Achamma*

George^{1,3}, *P. Predeep*¹; ¹Natl. Inst. of Technology Calicut, India, ²MSM College Kayamkulam, India, ³St. Stephans' College, India.

Films of SeTeIn Chalcogenide glasses are prepared by melt quenching followed by flash evaporation. Their optical constants and variations in refractive index, extinction and absorption coefficients with energy of incident radiation are evaluated and discussed.

ITuC • Imaging Sensors III

Sonoran II

4:30 p.m.–5:50 p.m.

Michael Kriss; MAK Consultants, USA, Presider

PDITuC1 • 5:30 p.m.

Focal Length Invariance of Perceptual Image Quality for Long Range Imaging Applications, *Joshua K. Lentz, James E.*

Harvey; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. For long range imaging applications, perceptual image quality will not vary with focal length. Theoretical justification and Modulation Transfer Function (MTF) evidence are presented.

Optical Remote Sensing of the Environment (ORS) Abstracts

•Monday, June 7, 2010•

OMD • Littoral Applications of Remote Sensing

Finger Rock

4:30 p.m.–6:30 p.m.

Charles M. Bachmann; NRL, USA, Presider

PDOMD1 • 6:10 p.m.

Retrieval of Cloud Properties Using a Principal Component Based Physical Methodology, *Wan Wu*¹, *Xu Liu*², *Daniel K.*

*Zhou*², *Allen M. Larar*²; ¹Science Systems and Applications, Inc., USA, ²NASA Langley Res. Ctr., USA. We present here the study of cloud top height and microphysical properties retrievals from the Infrared Atmospheric Sounding Interferometer (IASI) simulation radiance data using the PCRTM physical inversion algorithm.

•Tuesday, June 8, 2010•

PDOTuA • Sensors and Methods III

Finger Rock

4:30 p.m.–5:30 p.m.

Robert Fusina; NRL, USA, Presider

PDOTuA1 • 4:30 p.m.

Fabry-Perot Sensors for Precision Trace Gas Measurement, *William S. Heaps*¹, *Elena Georgieva*²; ¹NASA Goddard Space Flight Ctr., USA, ²Univ. of Maryland, Baltimore County, USA.

Fabry-Perots are useful for remote sensing. They can operate at high resolution while maintaining high brightness.

Instruments will be described to measure greenhouse gases on earth and to search for methane on Mars.

PDOTuA2 • 4:50 p.m.

DFB Lasers from 760 nm to 3400 nm for Sensing

Applications, *Lars Hildebrandt, Wolfgang Zeller, Lars Naehle, Peter Fuchs, Christian Zimmermann, Johannes Koeth; Nanoplus Nanosystems and Technologies GmbH, Germany.* We describe the status quo concerning DFB laser diodes between 760 nm and 3400 nm as well as new developments aiming for up to 80 nm tuning range, high power and low linewidth in this spectral region.

PDOTuA3 • 5:10 p.m.

Developing Heavy Metal Pollution Map with Multifactor

Contributed, Metin Altan, Ömer Ayyıldız, Semra Malkoç, Berna Yazici, Savas Koparal; Anadolu Univ., Turkey.

Detailed investigation was conducted to understand contamination characteristics and distributions of heavy metal pollution in terms of contributions of the heavy metal concentrations as mg/kg in the urban soil and modelled in recorded digital map.

Optics for Solar Energy (SOLAR) Abstracts

• Tuesday, June 8, 2010 •

**STuB • Concentrator Design and Holographic
Concentrator Systems**

Canyon III

10:50 a.m.–12:30 p.m.

R. John Koschel; Univ. of Arizona, USA, Presider

PDSTuB1 • 10:50 a.m.

Nanosphere Scattering Simulations for Efficient Thin Film

Solar Cells, Jagmeet S. Sekhon, S. S. Verma; Sant Longowal

Inst. of Engineering and Technology, India. Suitability simulations of plasmonic materials were demonstrated to enhance the absorption efficiency of Si solar cells and summarized that Cu nanosphere could be more creditable for plasmonic solar cells in comparisons to Ag and Au.

STuE • Solar Poster Session

Canyon III

7:00 p.m.–8:30 p.m.

PDSTuE1

An Improved Charge Controller Model for Solar Powered

Standalone Lighting Systems, Ajit P. S. Negi, Deepak Bagai,

Rita Mahajan; PEC Univ. of Technology, India. The paper proposes an improved charge controller scheme for solar power based standalone lighting systems, by efficient charging and discharging of battery through a common controller circuit with a well known technique, Pulse Width Modulation.

• Wednesday, June 9, 2010 •

SWB • Light Management and Spectrum Splitting

Canyon III

10:30 a.m.–12:30 p.m.

Cesar Domínguez; Univ. Polytechnica de Madrid, Spain, Presider

PDSWB1 • 11:30 a.m.

Fundamental Limit of Nanophotonic Light-Trapping in

Solar Cells, Zongfu Yu, Aaswath Raman, Shanhui Fan; Stanford

Univ., USA. We use a rigorous electromagnetic approach to develop a light-trapping theory, which reveals that the conventional limit $4n^2$ can be substantially surpassed in nanophotonic regimes, opening new avenues for highly efficient solar cells.

Key to Authors and Presiders
(**BOLD** denotes Presenting Author or Presider)

A

Altan, Metin—**PDOTuA3**

Ayyildiz, Ömer—**PDOTuA3**

B

Bachmann, Charles M.—**OMD**

Bagai, Deepak—**PDSTuE1**

D

Domínguez, Cesar—**SWB**

F

Fan, Shanhui—**PDSWB1**

Fuchs, Peter—**PDOTuA2**

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George, Achamma—**PDJTua1**

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Harvey, James E.—**PDITuC1**

Heaps, William S.—**PDOTuA1**

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Koeth, Johannes—**PDOTuA2**

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Zhou, Daniel K.—**PDOMD1**

Zimmermann, Christian—**PDOTuA2**