

Optical Fabrication & Testing (OF&T)

June 13-17 2010, The Snow King Resort, Jackson Hole, Wyoming, United States

Dating back to 1974, the Optical Fabrication and Testing topical meeting provides a forum to discuss all aspects of optics fabrication and testing ranging from micro-optics to large optics, and from high-value one-of-a-kind optics to mass-produced optics. [↴](#)

Take advantage of all OF&T has to offer:

- Two meetings for the price of one- Collocated with the [International Optical Design Conference \(IODC\)](#)
- Renowned [plenary speakers](#)
- More than 20 [invited speakers](#) discussing the latest breakthroughs in optical design
- [Tabletop exhibits](#)
- [Special H. John Wood Presentation on the Hubble](#)
- [Poster session providing one-on-one discussion time with presenters](#)

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

Special Events

- Plenary session featuring renowned speakers
- Conference Reception
- Poster session
- Special presentation on the Hubble by NASA's H. John Wood
- Best Student Paper Award Presentation

Sponsor:



Cooperating Society:



The organizers acknowledge the generous support from the following sponsors:



Optical Fabrication & Testing (OF&T)

June 13-17 2010, The Snow King Resort, Jackson Hole, Wyoming, United States

Program

The program for OF&T will be held Monday, June 14 through Thursday, June 17, 2010. No events are scheduled for Sunday, June 13; however participants may register and pick up their materials on Sunday afternoon.

- [About the meeting topics](#)
- [Special Events](#)
- [Invited speakers](#)
- [Call for papers](#)

Online Conference Program

- 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.

About Optical Fabrication and Testing

The Optical Fabrication and Testing Topical Meeting will bring together experts working in this field to discuss recent advances and to identify future trends. The meeting will cover all aspects of optics fabrication and testing ranging from micro-optics to large optics, and from high-value one-of-a-kind optics to mass-produced optics. The meeting will emphasize new ideas and concepts in fabrication and testing of micro-optics, the fabrication and testing of aspheric optics for optics materials and finishing science.

Topics of special interest for this IODC are illumination system fabrication, surface representation in lens design, desensitizing designs and reduction in cost, beam shaping, micro-optics, polarization, and computational imaging.

Submissions were encouraged in the following areas:

1. Optical Materials
 - New materials for new applications (polymers, crystals, glasses, lightweight materials, ceramics, carbides, UV optics materials)
 - Material response to fabrication processes, including subsurface damage
2. Fabrication, Figuring and Finishing Science
 - Grinding, precision grinding, diamond turning and milling, ultrasound assisted machining, vibration assisted polishing, laser processing
 - New ideas in traditional pitch and pad polishing, MRF, ion beam figuring and polishing, jet polishing, novel finishing processes
 - New polishing pitch formulations, lapping surface media, bound abrasive media-belts, pads, pellets, balls, membranes
 - Polishing slurries, characterization of slurries, slurry fluid chemistry, diamond polishing slurries, nonaqueous polishing slurries

- Acid etching in polishing
 - Extensions of electrolytic in-process dressing (ELID)
 - Friction and tribology in polishing
 - Glass and polymer molding
 - Abrasives, novel abrasive formulations
 - Aspheric optics, diffractive optics and free-form optics
 - Nano-structured optics
 - Optronics
3. Optical Testing
- Testing for sub-surface damage, homogeneity, form, finish, scratch/dig
 - New ideas in interferometry
 - Asphere metrology with and without null-optics
 - Computer-generated holograms and spatial light modulators for testing
 - Stitching interferometry
 - Testing of free-form optics and diffractive optics
 - Calibration and absolute tests for flats, spheres, and aspheres
 - New concepts in profilometry-optical and mechanical probes
 - Testing of very large and very small optics
 - White light interferometry, fringe projection metrology, deflectometry
 - Testing in adverse environments: vibration, turbulence, vacuum, space
 - In-process metrology
4. Alignment, Contamination Control, Cleaning and Packaging
- Adhesives, cementing, optical contacting, and direct bonding
 - Alignment of optical systems
 - Alignment of systems containing aspheric elements
 - Alignment of multi-element mirrors
 - Mounting, control of deformation and stress birefringence
 - Cleaning optics
 - Clean rooms and contamination control
 - Handling and packaging of precision optics
5. Process Engineering
- Cost-effective optics manufacturing processes
 - Cost-effective fabrication of aspheric surfaces
 - Automation in optics fabrication
 - Fabrication of large optics
 - Fabrication of micro-optics
 - Experiences from the shop floor
6. Optical System Assembly
- Photolithography optics
 - Telescopes
 - Microscopes
 - Adaptive optics
 - Integrated optics
 - Wavefront coded systems

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Special Events

Plenary Sessions

JMA • Joint IODC/OF&T Plenary Session

Monday, June 14, 2010, 8:00 a.m.–9:30 a.m.
Grand Room



8:10 a.m.–8:50 a.m.

JMA1, **Better Ways to Specify Aspheric Shapes Can Facilitate Design, Fabrication and Testing Alike**, [Greg Forbes](#): QED Technologies, USA

Modifying a widely used convention is rarely easy. With designers, fabricators, and metrologists gathered here, we have a rare opportunity to consider such a change in relation to optical aspheres. This evolving technology is currently burdened by the increasingly inadequate convention of expressing a rotationally symmetric asphere's sag as the sum of a conic component and an additive polynomial. When more than just a few terms appear in the polynomial, this becomes problematic and ultimately unworkable. Many of us are being burned by the fact that the associated coefficients are woefully unintuitive and inefficient. The norm is error-prone communications and a lack of easy options to appreciate the difficulty of manufacturing any particular asphere. Thankfully, the design and manufacture of increasingly complex aspheres is facilitated by a modified representation that is also ideal for exploiting cost-effective shapes. In particular, an orthogonalised representation gives a description that functions with fewer coefficients—typically using only one third the number of digits for current designs—and allows easy interpretations and sanity checks as well as direct assessments of manufacturability. Examples are presented to motivate us to confront this sooner rather than later.



8:50 a.m.–9:30 a.m.

JMA2, **Computational Imaging Technologies**, **Kenneth Kubala**; *FiveFocal, USA*

Many computational imaging technologies introduced in the last several years use optical, mechanical, sensor and computational degrees of freedom to enable special system characteristics. The general computational imaging framework will be discussed along with the value of some specific approaches. Additionally, a simplified design approach that does not require tools beyond what the designer is currently accustomed to will be described.

Joint IODC/OF&T Poster Session

Monday, June 14, 6:00 p.m.–8:00 p.m.

Exhibit Hall, Pavilion

Poster presentations offer a great way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. This year's joint poster session includes a number of outstanding presentations. There are nearly 30 IODC posters and nearly 15 OF&T posters scheduled for presentation.

Joint Conference Reception

Tuesday, June 15, 6:00 p.m.–7:30 p.m.

Atrium

Mingle with colleagues and friends from around the world during the conference reception. Light hors d'oeuvres will be served. Free to all technical conference attendees. Additional tickets can be purchased at Registration for US\$65.

OF&T Student Awards Ceremony and H. John Wood Presentation

Wednesday, June 16, 6:00 p.m.–7:30 p.m.

Teton Room

Attend this exciting session to hear about the winners of the OF&T Best Student Paper Award, followed by a talk on the Hubble by H. John Wood. Dessert and coffee will be served.

6:00 p.m.

OF&T Best Student Paper Award Presentation

Sponsored by:



Through the generous support of the OSA Foundation, the OF&T Best Student Paper Award has been established to encourage excellence in research and scientific presentation skills in the student optics community. Awards include a cash prize and a certificate. There will be first- and second-place winners for both oral and poster presentations.

Students participating in the competition are noted within the abstracts section of this program. Please support the next generation of optical engineers and scientists by attending the student presentations and the awards presentation.

6:30 p.m.

Hubble Anthology, H. John Wood; NASA Goddard Space Flight Ctr., USA



Dr. H. John Wood is an astronomer and serves as an optical engineer for the Optics Branch at NASA's Goddard Space Flight Center. Since June 1990, he has been Optics Lead Engineer on the Hubble Space Telescope (HST) Project. He led the team that successfully determined the optical prescription of HST while on orbit. He then led NASA's effort to develop and test the corrective optics for HST. In addition to his work on Hubble, he served as Science Liaison in the Instrument Synthesis & Analysis Laboratory for new Earth Science and Space Science instrument engineering design at Goddard. He has recently been assigned as optics lead engineer for the ATLAS project, a lidar altimeter aboard ICESat-2, to measure the ice on both poles of the Earth.

A graduate of Swarthmore College, Dr. Wood earned the M.A. and Ph.D. in Astronomy from Indiana University. He has been at Goddard Space Flight Center for over 20 years. In addition to the Hubble Project, he has been Lead Optical Engineer on other Goddard projects: the Mars Observer Laser Altimeter and the Diffuse Infrared Background Experiment aboard the Cosmic Background Explorer (COBE). Earlier he served as assistant to the director at Cerro Tololo Inter-American Observatory (Chile) for two years. He held a Fulbright Research Fellowship for two years at the University Observatory in Vienna, Austria. He also served five years as a staff astronomer at the European Southern Observatory in Chile. His career began with six years on the astronomy faculty of the University of Virginia at Charlottesville.

Winner of the 1992 NASA exceptional service medal and the 1994 NASA exceptional achievement medal for his work on COBE and HST, he is the author of more than 50 research papers in astronomy and space optics. He recently received the 2009 NASA Medal for exceptional service in outreach on the HST project. He was also awarded the 2009 Robert H. Goddard award of Merit for exceptional achievement in his career at Goddard. He was invited by The Optical Society to edit special editions of *Applied Optics* and *Optics and Photonics News* on the HST first servicing mission.

Come hear Dr. Wood talk about Hubble Space Telescope (HST), orbiting high above the turbulence of the earth's atmosphere and providing breathtaking views of astronomical objects never before seen in such detail. Understanding the images makes them even more beautiful.

Exhibits

Mezzanine-Grand/Lobby

Schedule plenty of time to visit with the many companies represented and see the latest products and technologies. For more information on the participating companies, see the Exhibit Guide.

Exhibit	Hours
Monday, June 14	9:30 a.m.-4:30 p.m.

Tuesday, June 15	10:00 a.m.-4:30 p.m.
Wednesday, June 16	10:00 a.m.-4:30 p.m.

Optical Fabrication & Testing (OF&T)

June 13-17 2010, The Snow King Resort, Jackson Hole, Wyoming, United States

Optical Fabrication and Testing (OF&T) Meeting and Exhibit *Co-located with International Optical Design Conference*

Exhibit: June 14-16, 2010 at The Snow King Resort, Jackson Hole, Wyoming, USA

These co-located OSA Topical Meetings will feature one combined exhibit. This is the event where 300-500 industry experts and top scientists and developers will share their latest research and collaborate on new and future applications within this specialized field. The meetings will focus on the most advanced developments within these two specific topical areas of the optics and photonics industry. Exhibiting at this combined exhibit offers you an extremely targeted opportunity to display your company's products that fall within these co-located topical meeting areas.

Current Exhibitor List (as of May 25, 2010)

4D Technology
CDGM Glass
Engineering Synthesis Design
Jenoptik
Lacroix Optical
Optical Perspectives
Optical Research Associates
Optikos
Optimax
ORA
Photon Engineering
Photonics Media
Schott
Zeeko
Zemax
Zygo

Sponsorship Opportunities for OSA Optics and Photonics Congresses

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.

International Optical Design Conference Optical Fabrication & Testing 2010 Topical Meetings and Tabletop Exhibits

June 13-17, 2010 ♦ Snow King Resort, Jackson Hole, WY

- International Optical Design Conference (IODC)
- Optical Fabrication and Testing (OF&T)

Welcome!

We are glad you will be joining us in Jackson Hole! This packet should include what you need to prepare for the meeting. If you have any questions or need more information, please contact Catherine Brosnan, Meetings Coordinator, at topicalexhibits@osa.org or +1 202.416.1995.

Exhibitor Service Manual

Please provide this information to anyone who will be attending the meeting and staffing your company's table.

All exhibit space will be assigned on-site based on the order of when a space contract was received.

Deadlines Summary

Date	Deadline
May 11, 2010	75-word description and company logo (.jpg preferred) due for exhibitor listings
May 11, 2010	Final day to request complimentary ID sign (Exhibitor Response Form)
May 11, 2010	Housing reservations due
May 17, 2010	Registration forms due (fax to +1 202.416.6100 or email topicalexhibits@osa.org)
June 4, 2010	Final day to order electrical power through OSA.
June 8, 2010	Final day to order internet through Snow King.
June 8, 2010	Snow King Resort begins accepting shipments from exhibitors; shipments received any earlier will incur storage charges

Exhibit Schedule

(For a complete schedule of the meeting, visit

<http://www.osa.org/meetings/topicalmeetings/iocd/program/agenda/default.aspx>

Sunday, June 13

Event	Time
Registration Open	3:00 p.m. – 6:00 p.m.
Set-up	3:00 p.m. – 6:00 p.m.

Monday, June 14

Event	Time
Set-up	7:00 a.m. – 9:00 a.m.
Registration Open	7:00 a.m. – 6:00 p.m.
Exhibit Hours	9:30 a.m. – 4:30 p.m.
Coffee Breaks	9:30 a.m. – 10:00 a.m. & 4:00 p.m. – 4:30 p.m.

Tuesday, June 15

Event	Time
Registration Open	7:30 a.m. – 6:00 p.m.
Exhibit Hours	10:00 a.m. – 4:30 p.m.
Coffee Break	10:00 a.m. – 10:30 a.m. & 4:00 p.m. – 4:30 p.m.

Wednesday, June 16

Event	Time
Registration Open	7:30 a.m. – 5:30 p.m.
Exhibit Hours	10:00 a.m. – 4:30 p.m.
Coffee Breaks	10:00 a.m. – 10:30 a.m. & 4:00 p.m. – 4:30 p.m.
Tear-down (Please be aware of the noise level as sessions do not end until 9:30 pm)	4:30 p.m. – 7:00 p.m.

Exhibitors may set their own hours each day. We do not require that you remain at your table for the entire time since, in many cases, exhibit staff may want to attend sessions or keep in touch with the office. **However, tables should be staffed during Coffee Breaks.** For more information contact Catherine Brosnan at topical Exhibits@osa.org or +1 202.416.1995.

Set-up Hours

Sunday, June 13	3:00 p.m. – 6:00 p.m.
Monday, June 14	7:00 a.m. – 9:00 a.m.

All exhibitors must be ready and have their displays set no later than 9:30 a.m. on Monday, June 14. Any exhibitor not ready will need to wait and finish their set up between 12:30 p.m. – 2:00 p.m. on that day.

Tear-down Hours

Wednesday, June 16	4:30 p.m. – 7:00 p.m.
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Note: Session rooms are located near the exhibits. Please be aware of the noise level during tear-down as sessions will continue until 9:30 p.m.

Exhibit Details

The exhibit along with coffee breaks and poster sessions will be held in Mezzanine-Grand/Lobby of the Snow King Resort.

Exhibitors will be provided with a draped table and 2 chairs. A 7" x 44" (approx. 1.1m x 0.17m) company sign will be provided if ordered by the deadline. Your display must fit completely on the surface of the table for a total display space no larger than 6' x 2' x 8'. Decorations and signage may not be attached to or hung from any permanent structure. The total height all materials, including the table, must be no higher than 8 feet (approx. 2.5m).

Exhibitors will not receive the following items which must be ordered separately from the hotel:

- Electrical service
- Internet Service

Electrical Service - *Deadline: Friday, June 4, 2010*

Cost: \$25.00 per day (6% tax)

NOTE: No electrical orders can be placed on-site. It must be ordered in advance. All electrical services must be ordered through OSA using the order form included in this packet. Exhibitors are highly encouraged to bring their own extension cords, power strips and surge protectors. These items are available through the hotel for an additional charge. Power converters are not available and international exhibitors should bring these items. Electrical circuits may be non-exclusive and may be shared with other exhibitors. Power drops for needs over 20 amps are \$45.00 per day. Electrical will be charged tax (6%).

See Order Form for more information.

Internet Service - *Deadline: Tuesday, June 8, 2010*

Complimentary wireless service is available throughout the Snow King Resort. Wireless service is also available in the guest rooms in the official hotel block for no charge. Wired Internet service for the meeting room is available for a daily fee of \$20 plus a one-time set-up fee of \$70.

See Hotel's Order Form for more information.

Company ID Sign – *Deadline: Tuesday, May 11, 2010*

Any company wanting to receive a complimentary 7" x 44" ID sign must notify Management no later than Tuesday, May 11, 2010. Please use the notification form included in this packet, or send an email to topical Exhibits@osa.org.

Exhibitor Registration

Exhibitors may pick up their badges on-site at the registration desk during the following hours:

Date	Hours
Sunday, June 13	3:00 p.m. – 6:00 p.m.
Monday, June 14	7:00 a.m. – 6:00 p.m.
Tuesday, June 15	7:30 p.m. – 6:00 p.m.
Wednesday, June 16	7:30 p.m. – 5:30 p.m.
Thursday, June 17	7:30 a.m. – 10:00 a.m.

Exhibitor Badges – *Deadline: Monday, May 17, 2010*

Exhibitors – Do not use online registration. Fax the completed registration form to +1 202.416.6100 ATTN: Cathryn Wanders by Monday, May 17.

Each person attending the meeting must have a badge. Each exhibiting company will receive three complimentary badges:

1. Exhibitor Technical Badge – includes access to all technical sessions and receptions; one copy of technical digest on CD-ROM; one copy of conference program
2. Exhibitor Personnel Badge – access to the exhibit hall only
3. Exhibitor Personnel Badge – access to the exhibit hall only

If an additional registration is needed, that person must purchase a technical registration. The registration form is included with this packet.

Exhibitor Listing – *Deadline: Tuesday, May 11, 2010*

If you have not already done so, please email a 50-75 word description of your company (including complete contact information) plus company logo in JPG format (black/white or color) to Exhibit Management at topical Exhibits@osa.org. To have your description included in the Exhibitor Listings, it

must be received as soon as possible but no later than 5/11. This listing will be distributed to each registrant at the meeting. If you have any questions about the technical program, please email Erin Richardson at ericha@osa.org.

Security

The exhibit will be held in an open Mezzanine outside of the meeting rooms that will NOT be locked each night. It is strongly recommended that you take any valuable equipment (i.e. laptops, small components, other materials) with you or secure them each night. It is also recommended that you bring a drape or cloth to cover your table each night. Each exhibitor is required to have adequate insurance levels, and basic precautions should be taken. Reference your contract for required insurance levels.

Transportation

For more information about transportation to the hotel, including airline and rental car discounts and links to public transportation, go to <http://www.osa.org/meetings/topicalmeetings/OFT/housingandtravel/transportation/default.aspx>.

The closest airport is Jackson Hole Airport (JAC).

Airport Shuttle Information

Arriving Guests:

- Guests should contact the Snow King Resort the day prior to departure to arrange for a shuttle pick up: **+1 800.522.KING** (5464) or direct at **+1 307.733.5200**
- The shuttle will be waiting outside the airport's main entrance.
- The shuttle is complimentary; but, gratuities are greatly appreciated

Departing Guests:

- Departing guests can get back to the airport by contacting the front desk agent **one day prior** to their departure.
- The shuttle is complimentary; gratuities, however, are greatly appreciated.

Parking

Parking at the Snow King Resort is complimentary for guests and visitors.

LocalTransportation Information

A free Town Shuttle is available from the Snow King Resort to the town of Jackson. Please contact the concierge for a schedule and more information. START Bus provides service from Jackson to Teton Village.

Housing – *Deadline: Tuesday, May 11, 2010*

A block of sleeping rooms has been reserved for the convenience of meeting attendees and exhibitors at the Snow King Resort. The meeting's room rates are:

Single Room	USD \$ 185
Double Room	USD \$ 185
Extra Person Charge	USD \$ 10

Attendees who book with in the meeting block will receive complimentary in-room wireless internet access.

Reservations may be made by calling the hotel toll-free at ++1 800.522.KING (5464) or direct at +1 307.733.5200 and requesting the Optical Society (OSA) group rate.

Reservations may also be made through Fax, Mail or Email. Please visit our Housing website at: <http://www.osa.org/meetings/topicalmeetings/OFT/housingandtravel/hotelreservations/default.aspx>.

The Snow King Resort must receive reservations **no later than 5/11/10**. After this date, the balance of the rooms will be released to the hotel.

Deposits and Cancellations:

1. One (1) night room and tax will be charged to your credit card upon making your reservation.
2. Reservations may be cancelled 72 hours prior to arrival to receive a full refund. Cancellations received within 72 hours of arrival will forfeit one (1) night's room and tax deposit.
3. Full payment in advance is not required.

Snow King Resort
 400 E Snow King Ave
 PO Box SKI
 Jackson Hole, WY 83001
 United States

Tel.: +1 307.733.5200
 Fax: +1 307.733.4086

Shipping & Material Handling

Material Handling

The hotel will be available to help all exhibitors with their shipments. The hotel does have a freight elevator and can accept large boxes. The hotel generally does not accept pallets. If needed, please notify topicalexhibits@osa.org in advance and we will work with you to have your shipment delivered. Additional charges may be applied.

The hotel will begin accepting packages June 8th.

All packages must be shipped off property within 24 hours of completion of meeting.

There are no fees/charges for package handling of a reasonable nature.

- Each Exhibitor will be responsible for packing and labeling of all outgoing materials and filling out the Shipping Form.
- There are no fees/charges for package handling of a reasonable nature.

Shipping Address

IODC/OF&T 2010 Exhibits
c/o *Guest Name*
Company
Snow King Resort & Grand View Lodge
400 E. Snow King Ave.
Jackson Hole, WY 83001

Air Freight/Cargo

STS Air Cargo is available to assist those companies who need to ship exhibit materials to Jackson Hole.

For more information, please contact:

Mike Carver
STS Air
PO Box 998
Millbrae, CA 94030
stsair@stsair.com
Phone: +1 800.692.6116
Fax: +1 650.692.6175

Customs

TWI Global will assist those companies which need to ship exhibit materials internationally. All materials shipped through TWI will be delivered to the hotel no later than Friday, June 11, 2010. For more information, please contact:

Alison Minichiello
TWI Group, Inc.
Tel: +1 718.995.0500
aminichiello@twiglobal.com
230-59 International Airport Center Blvd.
North Lobby, Suite #250
Jamaica, New York 11413

Promotional Opportunities

Take advantage of the opportunity to maximize your company's meeting presence through the unique sponsorships available at the IODC/OF&T meetings. Increase your company's visibility among qualified attendees while utilizing a cost-effective way to gain a competitive advantage. Don't miss your chance to reach hundreds of attendees!

To take advantage of a sponsorship opportunity, please call +1 202.416.1474 or email Regan Pickett at rpickett@osa.org.

For more information on exhibiting, please contact:

IODC/OF&T 2010
OSA Meetings and Exhibits Department
2010 Massachusetts Ave., NW
Washington, DC 20036
Tel: +1 202.416.1974 / Fax: +1 202.416.1408
Email: topical Exhibits@osa.org

The Snow King Resort

EXHIBITOR ELECTRICAL FORM

EXHIBITOR INFORMATION		PAYMENT INFORMATION	
CONFERENCE / GROUP / SHOW NAME: The Optical Society (IODC/OF&T)		* Client agrees to pay in full for loss or theft of any equipment provided by The Snow King Resort. * A 6% sales tax will be added to all charges.	
EXHIBITOR / VENDOR COMPANY:		CHECK ONE: [] VISA [] MASTERCARD [] AMERICAN EXPRESS	
ORDERED BY:	ON SITE CONTACT(S):	CARD HOLDER'S NAME:	
ADDRESS:		CREDIT CARD NUMBER:	EXP. DATE:
CITY, STATE, ZIP:	PHONE:	INSTALLATION DATE:	DISMANTLE DATE:

ELECTRICAL NEEDS:

Standard Service: Extension Cord \$25.00/day	Maximum Service: Power Drop (for needs over 20 amps) \$45.00/day
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~ Please fax or email completed form, **no later than June 4, 2010**, to:
 Catherine Brosnan - +1 202.416.6100 OR cbrosn@osa.org

~ No services will be available at the meeting



Internet and Data Services
For Wyoming

CONTRACT
For High-Speed Internet Services

Customer Information

Customer Name:	
Billing Address:	
Billing City:	
Billing State:	
Billing Zip:	
Billing Contact:	
Billing Contact Phone #:	

Billing note: Customer will pay Snow King Resort at check out time. Snow King Resort handles all required payments to **Wyoming.com**.

Exhibit Room(s)

Room Name	Service Start Date	Service End Date	Other Info (OPTIONAL)

Pricing Schedule – Per Day Service Rates

Description And Cost Per Day Of Service	Total # Of Days	Total Cost
256kbps @ \$20.00 per day	days	\$0.00
<Select One>	days	\$.00
Total Internet Access Service Charges:	\$0.00	

Pricing Schedule – One-Time Installation & Setup Charges

Company	One-Time Installation & Setup Charge
Wyoming.com	\$50.00
Snow King Resort	\$20.00
Total One-Time Charges:	\$70.00

Grand Total Charges

Total Internet Access Service Charges	\$.00
Total One-Time Charges	\$70.00
Grand Total Charges (Service & One-Time):	\$.00

Due to the nature of the Internet, services may be unavailable from time to time. Neither **Wyoming.com** nor Snow King Resort shall be liable for any interruption in service. Should all services be unavailable due to line outages or equipment failure, customer shall be entitled only to a partial or full credit for this outage. In no case will liability exceed the maximum amount outlined in this Contract Addendum.

Phone (307) 856-6400
FAX (307) 856-1499

937 W. Main Street
Riverton, WY 82501

sales@wyoming.com
www.wyoming.com



Internet and Data Services
For Wyoming

Project Scope Overview & Definition

- I. **Wyoming.com** and Snow King Resort will provide the following services:
 - 1. High-speed Internet service as selected and defined on page 1 of this contract.
 - 2. A single 10/100 Ethernet hand-off to connect to Customer provided HUB, Switch or Computer/Laptop.
 - 3. A single public (ARIN) static IP Address for WAN interface of Firewall or Router.

- II. Service from **Wyoming.com** and Snow King Resort **does not include** the following:
 - 1. Firewall – customer(s) must supply their own Firewall or Network Security.
 - 2. Switch or HUB – customer(s) must supply their own (if necessary).
 - 3. VPN capabilities – high-speed broadband service **will** support a VPN Tunnel if Customers Firewall will support VPN Tunnels.
 - 4. Static public (ARIN) IP Addresses per workstation. Static public IP Address(es) are available as an optional service from **Wyoming.com** and Snow King Resort.
 - 5. Computer or Laptop – customer(s) must supply their own Computer(s) and/or Laptop(s).

Special Notes or Instructions (Customer Specific Information)

Agreed to this **29** day of **May, 2008** between the following parties:

AGREED TO BY (CUSTOMER):		ACCEPTED BY (Snow King Resort / Wyoming.com)	
Signature	Date	Signature	Date
Print (or type) Name & Title		Print (or type) Name & Title	

International Optical Design Conference (IODC) Topical Meeting and Tabletop Exhibits

Collocated with: Optical Fabrication and Testing

June 13-17, 2010 * Jackson Hole, Wyoming, USA

One registrant per form

SECTION A: BADGE INFORMATION – PLEASE PRINT CLEARLY

Do you want all OSA correspondence and subscriptions sent to the address listed below? Yes No

Last (Family) Name	First (Given) Name	Middle Initial
Professional Affiliation/Institution	Title	
Mailing Address		
City	State/Province	ZIP/Postal Code
Country	Email	
Telephone with Country Code	Fax with Country Code	
Emergency Contact (In case of emergency)	Phone with Country Code	
SOCIETY MEMBERSHIP INFORMATION: <input type="checkbox"/> The Optical Society (OSA) ID# _____	<input type="checkbox"/> SPIE ID# _____	

SECTION B: CONFERENCE REGISTRATION

I. Full Technical Registration – Includes admission to all IODC/OF&T technical sessions, exhibit, refreshments, the conference reception, and one copy of the IODC/OF&T 2010 Conference Program and Technical Digest on CD-ROM. IODC Proceedings are only included where indicated. Proceedings will not be sold at the meeting. **Students must provide valid student I.D. to receive the discounted registration.** Forms received without payment will not be processed. Forms received after the deadline of May 17, 2010 will be charged the higher fee.

	On or before May 17, 2010	After May 17, 2010
Printed and CD-ROM IODC Proceedings included:		
OSA/SPIE Member	<input type="checkbox"/> US\$ 615	<input type="checkbox"/> US\$ 720
Non-member	<input type="checkbox"/> US\$ 780	<input type="checkbox"/> US\$ 885
Printed IODC Proceedings ONLY included:		
OSA/SPIE Member	<input type="checkbox"/> US\$ 610	<input type="checkbox"/> US\$ 715
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Proceedings Sold Separately:		
Emeritus/ OSA/SPIE Student Member	<input type="checkbox"/> US\$ 170	<input type="checkbox"/> US\$ 260
Student Non-member	<input type="checkbox"/> US\$ 230	<input type="checkbox"/> US\$ 320

II. Exhibit Only Registration - Only includes admission to the exhibit hall for attendees. US\$ 0

III. Exhibitor Technical Registration – One complimentary technical badge per Tabletop Space (subject to verification). EXT includes admission to all IODC/OF&T technical sessions, exhibit, refreshments, conference reception, and one copy of the 2010 Conference Program and Technical Digest on CD-ROM. IODC Proceedings NOT included.

Complimentary Technical Badge US\$ 0 US\$ 0

IV. Exhibit Personnel Only – Only includes admission to the exhibit hall for exhibitor staff. US\$ 0 US\$ 0

SECTION B PAYMENT \$ _____

SECTION C: CONFERENCE PUBLICATIONS

One copy of the IODC/OF&T 2010 Conference Program and Technical Digest on CD-ROM is included in the Full Technical and Exhibitor Technical Registration fee.

Additional copies are available for purchase.

Extra IODC/OF&T 2010 Program and Technical Digest on CD-ROM _____ x US\$ 75

IODC Proceedings: Proceedings may be included based on your selection above. Additional copies of proceedings will not be available for sale at the meeting.

IODC Printed and CD-ROM Proceedings _____ x US\$ 75

IODC Printed Proceedings _____ x US\$ 70

IODC CD-ROM Proceedings _____ x US\$ 50

SECTION D PAYMENT \$ _____

SECTION E: ADDITIONAL PRODUCTS

Admission to the conference reception is included in the Full Technical and Exhibitor Technical Registration fee. Guest tickets may be purchased for \$65 per person.

Extra IODC/OF&T Reception Tickets

No. of Guests _____ x US\$ 65

Paid Registrant – No Charge

OSA Foundation Donation

US\$25

SECTION E PAYMENT \$ _____

TOTAL PAYMENT \$ _____

SECTION F: PAYMENT INFORMATION

One registrant per form. This form can be copied for additional registrants. **PAYMENT MUST ACCOMPANY FORM TO COMPLETE PROCESSING.**

Your name and full address must be typed or printed clearly on your check or bank draft.

Method of Payment: (Make check payable to the **Optical Society of America** in US dollars on a US bank)

Check No. _____ Money Order No. _____ Bank Name _____ Date of Transfer _____

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I authorize OSA to charge the on-site registration rate as stated in Section B. Payment amount subject to membership verification.

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Refund Policy for pre-registration: A \$75 service charge will be assessed for processing refunds. A letter requesting the refund should state the registrant's name and to whom the refund should be made payable. Requests for refunds must be received in writing no later than May 24, 2010 to be honored. Details should be mailed to OSA Meetings and Exhibits, 2010 Massachusetts Ave., NW, Washington, DC, 20036-1012 or faxed to 1.202.416.6140.

For Special Assistance while attending this meeting, call 1.202.416.1907.

 Registration implies consent that any picture taken during OSA sponsored events can be used for meeting and promotional purposes without remuneration and that your name will be placed on an attendee list which is distributed to IODC/OF&T Exhibitors.

THREE WAYS TO REGISTER



Fax:
1.202.416.6140



Mail: OSA Finance Department
c/o IODC 2010 Registration
P.O. Box 1976
Baltimore, MD 21298-8329



Express Mail: OSA Finance Dept.
c/o IODC 2010 Registration
2010 Massachusetts Ave., NW
Washington, DC 20036-1012

Optical Fabrication and Testing (OF&T) Topical Meeting and Tabletop Exhibits

Collocated with: International Optical Design Conference (IODC)

June 13-17, 2010 * Jackson Hole, Wyoming, USA

One registrant per form

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Do you want all OSA correspondence and subscriptions sent to the address listed below? Yes No

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	On or before May 17, 2010	After May 17, 2010
OSA/SPIE Member	<input type="checkbox"/> US\$ 540	<input type="checkbox"/> US\$ 645
Non-member	<input type="checkbox"/> US\$ 705	<input type="checkbox"/> US\$ 810
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Student Non-member	<input type="checkbox"/> US\$ 230	<input type="checkbox"/> US\$ 320

II. Exhibit Only Registration - Only includes admission to the exhibit hall for attendees. US\$ 0 US\$ 0

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Complimentary Technical Badge US\$ 0 US\$ 0

IV. Exhibit Personnel Only – Only includes admission to the exhibit hall for exhibitor staff. US\$ 0 US\$ 0

SECTION B PAYMENT \$ _____

SECTION C: CONFERENCE PUBLICATIONS

One copy of the IODC/OF&T 2010 Conference Program and Technical Digest on CD-ROM is included in the Full Technical and Exhibitor Technical Registration fee. Additional copies are available for purchase.

Extra IODC/OF&T 2010 Program and Technical Digest on CD-ROM _____ x US\$ 75

IODC Proceedings: Proceedings are not included with the registration fee. Additional copies of proceedings will not be available for sale at the meeting.

IODC Printed and CD-ROM Proceedings _____ x US\$ 75

IODC Printed Proceedings _____ x US\$ 70

IODC CD-ROM Proceedings _____ x US\$ 50

SECTION D PAYMENT \$ _____

SECTION E: ADDITIONAL PRODUCTS

Admission to the conference reception is included in the Full Technical and Exhibitor Technical Registration fee. Guest tickets may be purchased for \$65 per person.

Extra IODC/OF&T Reception Tickets _____ No. of Guests _____ x US\$ 65 Paid Registrant – No Charge

OSA Foundation Donation US\$25

SECTION E PAYMENT \$ _____

TOTAL PAYMENT \$ _____

SECTION F: PAYMENT INFORMATION

One registrant per form. This form can be copied for additional registrants. **PAYMENT MUST ACCOMPANY FORM TO COMPLETE PROCESSING.**

Your name and full address must be typed or printed clearly on your check or bank draft.

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Express Mail: OSA Finance Dept.
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2010 Massachusetts Ave., NW
Washington, DC 20036-1012

International Optical Design Conference (IODC)

Optical Fabrication and Testing (OF&T)

June 13–17, 2010
The Snow King Resort
Jackson Hole, Wyoming, USA

Conference Program

IODC is Co-Sponsored by OSA and SPIE.
OF&T is Sponsored by OSA in Cooperation with SPIE.



The organizers acknowledge the generous support from the following sponsors:



International Optical Design Conference (IODC)

June 13–17, 2010
Jackson Hole, Wyoming, USA

Welcome to the 2010 International Optical Design Conference (IODC) taking place in beautiful Jackson Hole, Wyoming, USA. This quadrennial event brings together an international group of experts and practitioners of optical and illumination design, research and engineering. This year we have an abundance of outstanding plenary, invited and contributed talks in a wide variety of areas. We have speakers from many different parts of the world working in diverse industries, government labs and educational institutions. The program committee has once again done an excellent job of promoting the conference, providing input on speakers, soliciting contributed papers and reviewing submissions. Additionally, we are very pleased to be collocated with Optical Fabrication and Testing, which is a natural technical partner for our conference.

The 2010 IODC features three plenary speakers. Dr. Greg Forbes from QED Technologies will speak on “Better Ways to Specify Aspheric Shapes Can Facilitate Design, Fabrication and Testing Alike.” Dr. Kenny Kubala from FiveFocal will then give a talk on “Computational Imaging Technologies.” The third plenary talk will be given by Professor Axel Scherer from Caltech on “The Evolution from III-V Opto-Electronics to Silicon Nanophotonics and Vertical Cavity Lasers to Photonic Crystal and Surface Plasmon Devices.”

Highlighted in this IODC are papers on surface representation in lens design, desensitizing and tolerancing optical systems, lighting and nonimaging system design, illumination system fabrication, beam shaping, polarization, and computational imaging. The illumination program has 5 full oral sessions and 10 invited talks, and the imaging program consists of 10 full oral sessions with 11 invited papers. Monday night will feature a strong joint poster session with OF&T. Tuesday night after the conference reception, the memorial program will feature tributes to the influential community members who have passed away since the last IODC. The results of the illumination and optical design problems will be presented on Wednesday night. We will also announce the winner of the best student paper award at the conclusion of the design problem session.

We have been honored to serve as chairs for the community. We appreciate and thank the many people who continue to make the IODC a special event that captures the state of our exciting field. Thank you to everyone for taking the time and effort to travel to Wyoming, especially those who have traveled long distances, to interact and share your work and expertise with the community.

Please enjoy your time in Jackson Hole and we look forward to seeing you at future IODC meetings.



Julie L. Bentley
Inst. of Optics, Univ. of Rochester,
USA, Co-Chair



Anurag Gupta
Optical Res. Associates, USA,
Co-Chair



Richard Neil Youngworth
Light Capture, Inc., USA,
Co-Chair

Optical Fabrication and Testing (OF&T)

June 13–17, 2010
Jackson Hole, Wyoming, USA

Welcome to the 2010 Topical Meeting on Optical Fabrication and Testing (OF&T), which convenes for the first time at the Snow King Resort in Jackson Hole, Wyoming, USA. We chose this location and the week of June 14th–17th to co-locate with the International Optical Design Conference (IODC), since the two meetings share many common themes.

We co-chairs and program committee members of OF&T are very pleased with the high level of participation, from within the USA and internationally. All topics of interest to the precision optics community are amply represented with 26 invited talks, over 60 contributed papers and 14 poster presentations.

OF&T will kick off Monday morning with a plenary session, joint with IODC, featuring two speakers: Dr. Greg Forbes on "Better Ways to Specify Aspheric Shapes Can Facilitate Design, Fabrication and Testing Alike" and Dr. Kenny Kubala on "Computational Imaging Technologies." OF&T will then split off for a series of sessions that address advances in interferometry, the manufacture and testing of aspherics and freeform optics, molded-micro-diffractive- and integrated optics, and CNC grinding-polishing of optics from small to large. Focus sessions will cover topics such as mid-spatial frequency artifacts, PSD, and tolerancing-uncertainty-accuracy. Additional work, led by invited presentations, will explore new applications of optical materials, from chalcogenide glasses to SiC to spinel for armor. Laser/material interactions will be covered with invited presentations on laser microfabrication of devices in glass, and surface processing to increase laser system survivability. A highlight of the week will be a Wednesday evening talk by Dr. H. John Wood entitled, "Hubble Anthology."

We have a special interest in highlighting scientific and technical contributions by the next generation of professionals in our field of work, and 13 poster/oral presentations, authored by students, will be given during the week. Cash prizes for the best poster and oral presentations will be awarded by the program committee.

We appreciate that many of you have come long distances in this challenging economic climate, to be together with longstanding friends and colleagues. We encourage you to renew acquaintances, to mingle and meet other members of the OF&T community with like interests, and to make new contacts and friendships.

Thank you for coming and contributing to OF&T 2010. Enjoy your time in Jackson Hole.



Stephen Jacobs
Univ. of Rochester, USA,
Co-Chair



Jessica DeGroot Nelson
Optimax Systems Inc.,
USA, Co-Chair



Jannick Rolland
Inst. of Optics, Univ. of
Rochester, USA, Co-Chair



Shai Shafrir
OptiPro Systems, Inc.,
USA, Co-Chair

Conference Highlights

Plenary Speakers

JMA • Joint IODC/OF&T Plenary Session

Monday, June 14, 2010, 8:00 a.m.–9:30 a.m.

Grand Room



8:10 a.m.–8:50 a.m.

JMA1, **Better Ways to Specify Aspheric Shapes Can Facilitate Design, Fabrication and Testing Alike**, Greg Forbes; QED Technologies, USA

Modifying a widely used convention is rarely easy. With designers, fabricators, and metrologists gathered here, we have a rare opportunity to consider such a change in relation to optical aspheres. This evolving technology is currently burdened by the increasingly inadequate convention of expressing a rotationally symmetric asphere's sag as the sum of a conic component and an additive polynomial. When more than just a few terms appear in the polynomial, this becomes problematic and ultimately unworkable. Many of us are being burned by the fact that the associated coefficients are woefully unintuitive and inefficient. The norm is error-prone communications and a lack of easy options to appreciate the difficulty of manufacturing any particular asphere. Thankfully, the design and manufacture of increasingly complex aspheres is facilitated by a modified representation that is also ideal for exploiting cost-effective shapes. In particular, an orthogonalised representation gives a description that functions with fewer coefficients—typically using only one third the number of digits for current designs—and allows easy interpretations and sanity checks as well as direct assessments of manufacturability. Examples are presented to motivate us to confront this sooner rather than later.



8:50 a.m.–9:30 a.m.

JMA2, **Computational Imaging Technologies**, Kenneth Kubala; FiveFocal, USA

Many computational imaging technologies introduced in the last several years use optical, mechanical, sensor and computational degrees of freedom to enable special system characteristics. The general computational imaging framework will be discussed along with the value of some specific approaches. Additionally, a simplified design approach that does not require tools beyond what the designer is currently accustomed to will be described.

IMA • Surface Plasmons Plenary, Emerging Technologies and Fundamental Optical Design, and Kidger and Hilbert Award Presentations

Monday, June 14, 2010, 10:00 a.m.–12:30 p.m.

Grand Room



10:00 a.m.–10:40 a.m.

IMA1, **The Evolution from III-V Opto-Electronics to Silicon Nanophotonics and Vertical Cavity Lasers to Photonic Crystal and Surface Plasmon Devices**, Axel Scherer, Uday Khankhoje, Tom Baehr-Jones, Se-Heon Kim; Caltech, USA

Lithography and dry etching has evolved to replace accurate crystal growth that enabled the definition of high-Q optical cavities in the past with dry etching approaches to define ultra-small mode volumes. These "printed" optical cavities can now be used to define micro- and nano-lasers in which the three-dimensional geometry is used to control the laser performance, and that can be lithographically coupled together in-plane. Advanced microcavity lasers now include photonic crystal mirrors and surface plasmon

contact geometries. By combining new methods of design, fabrication and testing, it has become possible to develop higher-level abstract device design approaches that enable SPICE-like modeling of optical circuits. However, the complexity of back-reflections and the wave-like behavior of light in microfabricated geometries limit the applicability of these approaches. Here, the evolution of integrated opto-electronics into photonic crystals and plasmonics is reviewed, with an emphasis on the specific cases of miniaturized lasers, plasmonic light emitters and silicon photonics.

Michael Kidger Memorial Scholarship Presentation

Monday, June 14, 2010, 11:55 p.m.–12:10 p.m.

Grand Room

The Michael Kidger Memorial Scholarship was established in 1998 to honor Michael John Kidger, a well-respected educator, design software developer and member of the optical science and engineering community. A full description can be found online at www.kidger.com.



The First Ten Years of the Kidger Scholarship

Tina Kidger will present a short review of the establishment and organization of the Scholarship and a brief update on the ten Kidger Scholarship awardees to date. She will then present the award to this year's Awardee, *Braulio Fonseca Carneiro de Albuquerque, Natl. Inst. for Space Research, São Paulo, Brazil*.

Robert S. Hilbert Memorial Student Travel Grant Presentation

Monday, June 14, 2010, 12:10 p.m.–12:25 p.m.

Grand Room



The Robert S. Hilbert Memorial Student Travel Grant offers financial support to help defray the cost of student travel to the International Optical Design Conference (IODC), Frontiers in Optics (OSA's Annual Meeting) and other professional meetings. The grant was established in honor of Bob S. Hilbert (1941–2008), former Optical Research Associates (ORA®) President and CEO, who was a respected member of the optics community and enthusiastically embraced learning and optics education. The grant is sponsored by ORA, and administered by OSA Foundation.

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Joint IODC/OF&T Poster Session

Monday, June 14, 6:00 p.m.–8:00 p.m.

Exhibit Hall, Pavilion

Poster presentations offer a great way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. This year's joint poster session includes a number of outstanding presentations. There are nearly 30 IODC posters and nearly 15 OF&T posters scheduled for presentation.

Joint Conference Reception

Tuesday, June 15, 6:00 p.m.–7:30 p.m.

Atrium

Mingle with colleagues and friends from around the world during the conference reception. Light hors d'oeuvres will be served. Free to all technical conference attendees. Additional tickets can be purchased at Registration for US\$ 65.

Memorial Program

Tuesday, June 15, 7:00 p.m.–8:00 p.m.

Grand Room

Attend the special memorial program to celebrate the lives of influential community members who have passed away. We will pay tribute to the following luminaries:

7:00 p.m.–7:10 p.m. Hans Buchdahl
7:10 p.m.–7:20 p.m. Juan Rayces
7:20 p.m.–7:30 p.m. Jim Palmer
7:30 p.m.–7:40 p.m. Bob Hopkins
7:40 p.m.–7:50 p.m. Bob Hilbert
7:50 p.m.–8:00 p.m. Warren J. Smith

OF&T Student Awards Ceremony and H. John Wood Presentation

Wednesday, June 16, 6:00 p.m.–7:30 p.m.

Teton Room

Attend this exciting session to hear about the winners of the OF&T Best Student Paper Award, followed by a talk on the Hubble by H. John Wood. Dessert and coffee will be served.

OF&T Best Student Paper Award Presentation

6:00 p.m., *Teton Room*

Sponsored by:



Through the generous support of the OSA Foundation, the OF&T Best Student Paper Award has been established to encourage excellence in research and scientific presentation skills in the student optics community. Awards include a cash prize and a certificate. There will be first- and second-place winners for both oral and poster presentations.

Students participating in the competition are noted within the abstracts section of this program. Please support the next generation of optical engineers and scientists by attending the student presentations and the awards presentation.

Hubble Anthology, H. John Wood; NASA Goddard Space Flight Ctr., USA

6:30 p.m., Teton Room



Dr. H. John Wood is an astronomer and serves as an optical engineer for the Optics Branch at NASA's Goddard Space Flight Center. Since June 1990, he has been Optics Lead Engineer on the Hubble Space Telescope (HST) Project. He led the team that successfully determined the optical prescription of HST while on orbit. He then led NASA's effort to develop and test the corrective optics for HST. In addition to his work on Hubble, he served as Science Liaison in the Instrument Synthesis & Analysis Laboratory for new Earth Science and Space Science instrument engineering design at Goddard. He has recently been assigned as optics lead engineer for the ATLAS project, a lidar altimeter aboard ICESat-2, to measure the ice on both poles of the Earth.

A graduate of Swarthmore College, Dr. Wood earned the M.A. and Ph.D. in Astronomy from Indiana University. He has been at Goddard Space Flight Center for over 20 years. In addition to the Hubble Project, he has been Lead Optical Engineer on other Goddard projects: the Mars Observer Laser Altimeter and the Diffuse Infrared Background Experiment aboard the Cosmic Background Explorer (COBE). Earlier he served as assistant to the director at Cerro Tololo Inter-American Observatory (Chile) for two years. He held a Fulbright Research Fellowship for two years at the University Observatory in Vienna, Austria. He also served five years as a staff astronomer at the European Southern Observatory in Chile. His career began with six years on the astronomy faculty of the University of Virginia at Charlottesville.

Winner of the 1992 NASA exceptional service medal and the 1994 NASA exceptional achievement medal for his work on COBE and HST, he is the author of more than 50 research papers in astronomy and space optics. He recently received the 2009 NASA Medal for exceptional service in outreach on the HST project. He was also awarded the 2009 Robert H. Goddard award of Merit for exceptional achievement in his career at Goddard. He was invited by The Optical Society to edit special editions of *Applied Optics* and *Optics and Photonics News* on the HST first servicing mission.

Come hear Dr. Wood talk about Hubble Space Telescope (HST), orbiting high above the turbulence of the earth's atmosphere and providing breathtaking views of astronomical objects never before seen in such detail. Understanding the images makes them even more beautiful.

IODC Design and Illumination Problem Presentations and Student Awards Ceremony

Wednesday, June 16, 7:30 p.m.–9:30 p.m.

Grand Room

Join the IODC community for a guaranteed highlight of the conference: the illumination and lens design contest presentations. As usual, significant work has gone into developing and scoring the submissions, as well as all of the hard work put in by solution submitters. Additionally, the winners of the best student paper awards for the 2010 IODC will be announced at the conclusion of the design problem presentations.

Lens Design Problem

The "green" movement is all about conserving resources. When designing and manufacturing a lens, one way to minimize needed fabrication resources is to need only one testplate pair (positive and negative) plus an optical flat, and need only one type of optical glass. The Problem: Design a lens whose non-flat surfaces all share the same radius value, positive or negative, concave or convex.

Illumination Design Problem

The Problem: Transfer maximum monochromatic flux from a 1-mm-square Lambertian source in air to an equal-étendue nonimmersed target. The target surface is rectangular with a 16:9 aspect ratio. The surface area of the target must be at least 4 mm². The target is defined such that only rays incident on the target surface at angles of θ_{\max} or

less, relative to the surface normal, are considered to be within the phase space of the target, where the value of θ_{\max} is determined by the equal-étendue requirement.

IODC Best Student Paper Award Presentation

Sponsored by:



The IODC Best Student Paper Award has been established to encourage excellence in research and scientific presentation skills in the student optics community. Awards include a one-year OSA membership, a cash prize and a certificate.

Students participating in the competition are noted within the abstracts section of this program. Please support the next generation of optical engineers and scientists by attending the student presentations and the awards presentation.

Exhibits

Mezzanine-Grand/Lobby

Schedule plenty of time to visit with the many companies represented and see the latest products and technologies. For more information on the participating companies, see the Exhibit Guide.

Exhibit Hours	
Monday, June 14	9:30 a.m.–4:30 p.m.
Tuesday, June 15	10:00 a.m.–4:30 p.m.
Wednesday, June 16	10:00 a.m.–4:30 p.m.

Invited Speakers

IODC Illumination Design Invited Speakers

Monday

2:00 p.m.–2:30 p.m.

IMB1, A Practical and Predictive Two-Metric System for Characterizing the Color Rendering Properties of Light Sources for Architectural Applications, Mark S. Rea; Lighting Res. Ctr., Rensselaer Polytechnic Inst., USA

2:30 p.m.–3:00 p.m.

IMB2, From Enthusiasm to Economy: Precision Optical Design as a Key to Making LED Luminaires Cost-Efficient in Street Lighting and Architectural Lighting, Andreas Timinger; OEC AG, Germany

3:00 p.m.–3:30 p.m.

IMB3, Non-Visual Effects of Light: Implications for Design, Mariana Figueiro; Lighting Res. Ctr., Rensselaer Polytechnic Inst., USA

3:30 p.m.–4:00 p.m.

IMB4, Primary Optics for LEDs—State of the Art of Optical Architectures, Julius A. Muschaweck¹, Peter Brick¹, Stefan Grötsch¹, Simon Schwalenberg²; ¹OSRAM Opto Semiconductors, Germany, ²OSRAM GmbH, Germany

IODC Illumination Design Invited Speakers—Continued

Tuesday

2:00 p.m.–2:30 p.m.

ITuC1, **Evolution of Illumination Systems in Microlithography—A Retrospective**, *Alois Herkommer*; *Carl Zeiss SMT AG, Germany*

4:45 p.m.–5:15 p.m.

ITuE2, **Fluorescence Modeling in Remote and Close LED Illumination Devices**, *Teus Tukker*; *Philips Lighting, Netherlands*

Wednesday

10:45 a.m.–11:15 a.m.

IWB2, **Edge-Ray and Aplanatic Designs as Special Cases of Generalized Functional Designs**, *John C. Bortz*, *Narkis Shatz; SAIC, USA*

11:45 a.m.–12:15 p.m.

IWB5, **Optical Design of Inhomogeneous Media to Perfectly Focus Scalar Wave Fields**, *Pablo Benitez*, *Juan C. Miñano, Juan C. González; Univ. Politécnica de Madrid, Spain*

Thursday

8:15 a.m.–8:45 a.m.

IThA2, **Iterative Reflector Design Using a Cumulative Flux Compensation Approach**, *William Cassarly*; *Optical Res. Associates, USA*

9:00 a.m.–9:30 a.m.

IThA4, **Perturbative Design of Illumination Systems**, *R. John Koshel*^{1,2}; ¹*Photon Engineering LLC, USA*, ²*College of Optical Sciences, Univ. of Arizona, USA*

IODC Optical Design Invited Speakers

Monday

10:55 a.m.–11:25 a.m.

IMA3, **The Power of Negative Thinking**, *David Shafer*; *David Shafer Optical Design, USA*

11:25 a.m.–12:10 p.m.

IMA4, **Sixth-Order Wavefront Deformations: The Coefficients and Insights into Wavefront Propagation in Optical Systems**, *Jose Sasian*; *College of Optical Sciences, Univ. of Arizona, USA*

4:30 p.m.–5:00 p.m.

IMC1, **Application of Radial Basis Functions to Represent Optical Free-Form Surfaces**, *Ozan Cakmakci*¹, *Ilhan Kaya*², *Gregory E. Fasshauer*³, *Kevin P. Thompson*¹, *Jannick P. Rolland*³; ¹*Optical Res. Associates, USA*, ²*Univ. of Central Florida, USA*, ³*Inst. of Optics, Univ. of Rochester, USA*

5:30 p.m.–6:00 p.m.

IMC4, **Large Field-of-View and High Resolution Free-Form Head-Mounted Display**, *Dewen Cheng*^{1,2}, *Yongtian Wang*¹, *Hong Hua*²; ¹*Dept. of Optoelectronic Engineering, Beijing Inst. of Technology, China*, ²*3D Visualization and Imaging Systems Lab, College of Optical Sciences, Univ. of Arizona, USA*

IODC Optical Design Invited Speakers—Continued

Tuesday

8:30 a.m.–9:00 a.m.

ITuA3, **The 300-Year Quest for Binoculars**, *John Greivenkamp*, *David Steed*; College of Optical Sciences, Univ. of Arizona, USA

11:00 a.m.–11:30 a.m.

ITuB3, **Light Field Photography, Microscopy and Illumination**, *Marc Levoy*; Stanford Univ., USA

11:45 a.m.–12:15 p.m.

ITuB5, **Correcting Lateral Chromatic Aberrations by Image Processing**, *Akihiko Utsugi*, *Kenichi Ishiga*; Core Technology Ctr., Nikon Corp., Japan

Wednesday

8:45 a.m.–9:15 a.m.

IWA4, **Challenges for Polarization Ray Tracing**, *Russell A. Chipman*; College of Optical Sciences, Univ. of Arizona, USA

2:00 p.m.–2:30 p.m.

IWC1, **Unified Optical Modeling**, *Frank Wyrowski*¹, *Michael Kuhn*²; ¹Friedrich Schiller Univ. Jena, Germany, ²LightTrans GmbH, Germany

2:45 p.m.–3:15 p.m.

IWC3, **Mathematical Aspects of Laser Beam Shaping and Splitting**, *Louis A. Romero*¹, *Fred M. Dickey*²; ¹Sandia Natl. Labs, USA, ²FMD Consulting, USA

3:30 p.m.–4:00 p.m.

IWC5, **Microstructured Optics for Excimer-Based Systems: Applications for Imaging, Beam Shaping and Coherence Management**, *Robert Brunner*^{1,2}, *Hans Jürgen Dobschal*³, *Reinhard Steiner*², *Matthias Burkhardt*², *Matthias Cumme*², *Oliver Sandfuchs*², *Dennis Lehr*², *Michael Helgert*²; ¹Univ. of Applied Sciences Jena, Germany, ²Carl Zeiss Jena GmbH, Technology Div., Germany, ³Carl Zeiss AG, Central Res., Germany

OF&T Invited Speakers

Monday

10:00 a.m.–10:30 a.m.

OMA1, **Instantaneous Interferometry: Another View**, *Daniel M. Sykora*, *Peter de Groot*; Zygo Corp., USA

11:15 a.m.–11:45 a.m.

OMA5, **Stitching Interferometry—The Long and Winding Road...** *Michael Bray*; MBO-Metrology, France

2:00 p.m.–2:30 p.m.

OMB1, **Introduction to Surface Finish Metrology**, *Theodore Vorburger*; NIST, USA

2:45 p.m.–3:15 p.m.

OMB3, **Clash of Cultures: Uncertainty vs. Accuracy**, *Chris Evans*; Zygo Corp., USA

OF&T Invited Speakers— Continued

3:30 p.m.–4:00 p.m.

OMB5, **Pixel-Based Computations in Optical Metrology**, William P. Kuhn; Opt-E, USA

4:30 p.m.–5:00 p.m.

OMC1, **Chalcogenide Glasses: Their Unique Functionalities for Present and Potential Applications in Photonics**, Miroslav Vlcek¹, Himanshu Jain^{2,3}; ¹Faculty of Chemical Technology, Univ. of Pardubice, Czech Republic, ²Ctr. for Optical Technologies, Lehigh Univ., USA, ³Intl. Materials Inst. on New Functionality in Glass, Lehigh Univ., USA

5:30 p.m.–6:00 p.m.

OMC4, **An Overview of the Maturation of SiC Optics Fab**, Joseph Robichaud; L-3 Communications, SSG-Tinsley, USA

Tuesday

8:00 a.m.–8:30 a.m.

OTuA1, **International Standards for Optics in the Electronic Age**, Prudence M. J. H. Wormell; Imperial College, UK

9:30 a.m.–10:00 a.m.

OTuA6, **The Forbes Polynomial: A More Predictable Surface for Fabricators**, Kevin Thompson¹, Florian Fournier², Jannick P. Rolland², G. W. Forbes³; ¹Optical Res. Associates, USA, ²Inst. of Optics, Univ. of Rochester, USA, ³QED Technologies, Inc., USA

10:30 a.m.–11:00 a.m.

OTuB1, **Optical Testing of Mirrors for Giant Telescopes**, James Burge; Univ. of Arizona, USA

12:15 p.m.–12:45 p.m.

OTuB7, **Optical Figure Measurement on Convex or Concave Meter-Class Aspheres with Nanometer-Class Accuracy**, Paul Glenn; Bauer Associates, Inc., USA

2:00 p.m.–2:30 p.m.

OTuC1, **Ultrafast Laser Microfabrication of Photonic Devices inside Glass**, Kazuyoshi Itoh, Yasuyuki Ozeki; Osaka Univ., Japan

3:30 p.m.–4:00 p.m.

OTuC6, **Novel Optical Materials and Devices by Direct Laser Writing**, Georg von Freymann, Stefan Linden, Martin Wegener, Klaus Bade, Volker Saile, Michael Thiel, Michael S. Rill, Manuel Decker, Justyna Gansel; Karlsruhe Inst. of Technology (KIT), Germany

4:30 p.m.–5:00 p.m.

OTuD1, **Comparison of Linear Z-Axis and Rotational B-Axis Freeform Diamond Turning**, Gregg E. Davis¹, Jeffrey W. Roblee², Steven M. Omecinski¹, Alan Hedges¹; ¹II-VI Inc., USA, ²Ametek Precitech, USA

5:30 p.m.–6:00 p.m.

OTuD4, **Precise Fast Molding of Optical Freeforms**, Jan Hamkens; Docter Optics GmbH, Germany

OF&T Invited Speakers— Continued

Wednesday

8:00 a.m.–8:30 a.m.

OWA1, **Optical Fabrication and Post Processing Techniques for Improving Laser Damage Resistance of Fused Silica Optics**, Tayyab Suratwala; Lawrence Livermore Natl. Lab, USA

9:30 a.m.–10:00 a.m.

OWA6, **Development of Transparent Ceramic Spinel (MgAl₂O₄) for Armor Applications**, Anthony Sutorik; US ARL, USA

10:45 a.m.–11:15 a.m.

OWB2, **Corrosion Resistant Zirconia Coated Carbonyl Iron Particle-Based Magnetorheological Fluid**, Shai Shafrir^{1,2}, Henry J. Romanofsky³, Michael Skarlinski², Mimi Wang⁴, Chunlin Miao⁵, Sivan Salzman⁵, Taylor Chartier⁴, Joni Mici², John C. Lambropoulos², Rui Shen⁴, Hong Yang⁴, Stephen D. Jacobs³; ¹OptiPro Systems, Inc., USA, ²Dept. of Mechanical Engineering, Univ. of Rochester, USA, ³Lab for Laser Energetics, Univ. of Rochester, USA, ⁴Dept. of Chemical Engineering, Univ. of Rochester, USA, ⁵Materials Science Program, Dept. of Mechanical Engineering, Univ. of Rochester, USA

11:15 a.m.–11:45 a.m.

OWC1, **Glass Micro-Optics for Laser Beam Shaper and LED Collimation**, Steffen Reichel, Ralf Biertümpfel, Volker Wittmer; SCHOTT AG, Germany

2:00 p.m.–2:30 p.m.

OWD1, **Unique and Unusual Applications of Ultraprecision ELID Grinding and Diamond Cutting**, Hitoshi Ohmori; RIKEN, Japan

3:30 p.m.–4:00 p.m.

OWD6, **Advanced Molded Glass Lenses**, Jayson Nelson, Edward Patton; Rochester Precision Optics, USA

4:30 p.m.–5:00 p.m.

OWE1, **Power Spectral Density: Is It Right?**, John P. Lehan^{1,2}, Ulf Griesmann³, Jiyoung Chu^{3,4}; ¹NASA Goddard Space Flight Ctr., USA, ²Dept. of Physics, Univ. of Maryland, Baltimore County, USA, ³NIST, USA, ⁴Samsung Electronics Co., Republic of Korea

6:30 p.m.–7:15 p.m.

OWF1, **Hubble Anthology**, H. John Wood; NASA Goddard Space Flight Ctr., USA

Thursday

9:30 a.m.–10:00 a.m.

OThA5, **Fabrication of Aspheric Deposits by CW Laser Deposition**, Luis Rubio-Peña, José Andrés Ángel, Juan Valverde, Juan María González-Leal; Univ. of Cadiz, Spain

10:30 a.m.–11:00 a.m.

OThB1, **Polishing Glass—From Basic Investigations to Industrial Applications**, D. Waechter, R. Zunke, U. Schneider, O. Dambon, F. Klocke; Fraunhofer IPT, Germany

12:00 p.m.–12:30 p.m.

OThB6, **One Year of Finishing Meter-Class Optics with MRF® at L-3 IOS Brashear Optics**, François Piché, Andrew R. Clarkson; L-3 IOS Brashear Optics, USA

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Thanks to all the Technical Program Committee members! Your time and efforts are appreciated!

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	IODC Grand Room	IODC Lodge Room, Pavilion	OF&T Teton Room
Sunday, June 13			
3:00 p.m.–6:00 p.m.	Registration Open, Lobby		
Monday, June 14			
7:00 a.m.–6:00 p.m.	Registration Open, Lobby		
8:00 a.m.–9:30 a.m.	JMA • Joint IODC/OF&T Plenary Session		
9:30 a.m.–10:00 a.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
9:30 a.m.–4:30 p.m.	Exhibits Open, Mezzanine-Grand/Lobby		
10:00 a.m.–12:30 p.m.	IMA • Surface Plasmons Plenary, Emerging Technologies and Fundamental Optical Design, and Kidger and Hilbert Award Presentations		OMA • Interferometry
12:30 p.m.–2:00 p.m.	Lunch (on your own)		
2:00 p.m.–4:00 p.m.	IMB • Illumination Engineering: Principles and Practice		OMB • Metrology
4:00 p.m.–4:30 p.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
4:30 p.m.–6:00 p.m.	IMC • Optical Surface Representation and Freeform Design		OMC • Optical Materials
6:00 p.m.–8:00 p.m.	JMB • Joint IODC/OF&T Poster Session, Exhibit Hall, Pavilion		
Tuesday, June 15			
7:30 a.m.–6:00 p.m.	Registration Open, Lobby		
8:00 a.m.–10:00 a.m.	ITuA • Optical Systems I: Telescopes, Binoculars and Reflective Systems		OTuA • Specification and Measurement
10:00 a.m.–10:30 a.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
10:00 a.m.–4:30 p.m.	Exhibits Open, Mezzanine-Grand/Lobby		
10:30 a.m.–12:30 p.m.	ITuB • Optical Design for Modern Digital Systems and Computational Imaging (ends at 12:15 p.m.)		OTuB • Large Optics (ends at 12:45 p.m.)
12:30 p.m.–2:00 p.m.	Lunch (on your own)		
2:00 p.m.–4:00 p.m.	ITuC • Design and Applications of Illumination Systems	ITuD • Design and Analysis Considerations for Optical System Fabrication and Testing	OTuC • Laser Writing in Materials
4:00 p.m.–4:30 p.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby and Lodge Room, Pavilion		
4:30 p.m.–6:00 p.m.	ITuE • Modeling and Testing of Illuminations Systems and Components	ITuF • Manufacturing Considerations for Optical Design Producibility and Tolerance Desensitization	OTuD • Freeform Optics
6:00 p.m.–7:30 p.m.	Joint Conference Reception, Atrium		
7:00 p.m.–8:00 p.m.	Memorial Program, Grand Room		

	IODC Grand Room	OF&T Teton Room
Wednesday, June 16		
7:30 a.m.–5:30 p.m.	Registration Open, Lobby	
8:00 a.m.–10:00 a.m.	IWA • Polarization in Optical Design (ends at 9:45 a.m.)	OWA • Materials Processing and Damage
10:00 a.m.–10:30 a.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby	
10:00 a.m.–4:30 p.m.	Exhibits Open, Mezzanine-Grand/Lobby	
10:30 a.m.–12:30 p.m.	IWB • Nonimaging Optical Design Techniques	OWB • Materials Processing and Damage— Continued (10:30 a.m.–11:15 a.m.) ----- OWC • Micro-Integrated Optics (11:15 a.m.–12:30 p.m.)
12:30 p.m.–2:00 p.m.	Lunch (on your own)	
2:00 p.m.–4:00 p.m.	IWC • Beam Shaping and Propagation	OWD • Grinding/Cutting/Molding
4:00 p.m.–4:30 p.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby	
4:30 p.m.–6:00 p.m.	IWD • Optical Systems II: Zoom Lenses and Advanced Optical System Design (ends at 6:15 p.m.)	OWE • Mid-Spatials and PSD
6:00 p.m.–7:15 p.m.		OWF • Student Awards Ceremony and H. John Wood Presentation
7:30 p.m.–9:30 p.m.	IWE • Design and Illumination Problem Presentations and Student Awards Ceremony	
Thursday, June 17		
7:30 a.m.–10:00 a.m.	Registration Open, Lobby	
8:00 a.m.–10:00 a.m.	IThA • Design of Illumination Systems: Optimization and Tolerancing Approaches	OThA • Aspheres (starts at 8:30 a.m.)
10:00 a.m.–10:30 a.m.	Coffee Break, Mezzanine-Grand/Lobby	
10:30 a.m.–12:30 p.m.	IThB • What's in Your Optical Design and Analysis Toolkit?	OThB • Polishing

Key to Shading	
No shading	IODC Sessions
	OF&T Sessions
	Joint Sessions

Sunday, June 13, 3:00 p.m.–6:00 p.m. Registration Open, Lobby

Monday, June 14, 7:00 a.m.–6:00 p.m. Registration Open, Lobby

JMA • Joint IODC/OF&T Plenary

Monday, June 14

8:00 a.m.–9:30 a.m.

Kevin Thompson; Optical Res. Associates, USA, President

Opening Remarks • 8:00 a.m.

JMA1 • 8:10 a.m. Plenary

Better Ways to Specify Aspheric Shapes Can Facilitate Design, Fabrication and Testing Alike, *Greg Forbes; QED Technologies, USA.*

Modifying a widely used convention is rarely easy. With designers, fabricators, and metrologists gathered here, we have a rare opportunity to consider such a change in relation to optical aspheres. This evolving technology is currently burdened by the increasingly inadequate convention of expressing a rotationally symmetric asphere's sag as the sum of a conic component and an additive polynomial. When more than just a few terms appear in the polynomial, this becomes problematic and ultimately unworkable. Many of us are being burned by the fact that the associated coefficients are woefully unintuitive and inefficient. The norm is error-prone communications and a lack of easy options to appreciate the difficulty of manufacturing any particular asphere. Thankfully, the design and manufacture of increasingly complex aspheres is facilitated by a modified representation that is also ideal for exploiting cost-effective shapes. In particular, an orthogonalised representation gives a description that functions with fewer coefficients _typically using only one third the number of digits for current designs_ and allows easy interpretations and sanity checks as well as direct assessments of manufacturability. Examples are presented to motivate us to confront this sooner rather than later.

See the "Conference Highlights" section in the front of the book for more information on Greg Forbes, including a photo.

JMA2 • 8:50 a.m. Plenary

Computational Imaging Technologies, *Kenneth Kubala; FiveFocal, USA.*

Many computational imaging technologies introduced in the last several years use optical, mechanical, sensor and computational degrees of freedom to enable special system characteristics. The general computational imaging framework will be discussed along with the value of some specific approaches. Additionally, a simplified design approach that does not require tools beyond what the designer is currently accustomed to will be described.

See the "Conference Highlights" section in the front of the book for more information on Kenneth Kubala, including a photo.

9:30 a.m.–10:00 a.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby

9:30 a.m.–4:30 p.m. Exhibits Open, Mezzanine-Grand/Lobby

IMA • Surface Plasmons Plenary, Emerging Technologies and Fundamental Optical Design, and Kidger and Hilbert Award Presentations

Monday, June 14

10:00 a.m.–12:30 p.m.

Joseph Howard; NASA Goddard Space Flight Ctr., USA, Presider

IMA1 • 10:00 a.m. Plenary

The Evolution from III-V Opto-Electronics to Silicon Nanophotonics and Vertical Cavity Lasers to Photonic Crystal and Surface Plasmon Devices, Axel Scherer, Uday Khankhoje, Tom Baehr-Jones, Se-Heon Kim; Caltech, USA. Lithography and dry etching has evolved to replace accurate crystal growth that enabled the definition of high-Q optical cavities in the past with dry etching approaches to define ultra-small mode volumes. These "printed" optical cavities can now be used to define micro- and nano-lasers in which the three-dimensional geometry is used to control the laser performance, and that can be lithographically coupled together in-plane. Advanced microcavity lasers now include photonic crystal mirrors and surface plasmon contact geometries. By combining new methods of design, fabrication and testing, it has become possible to develop higher-level abstract device design approaches that enable SPICE-like modeling of optical circuits. However, the complexity of back-reflections and the wave-like behavior of light in microfabricated geometries limit the applicability of these approaches. Here, the evolution of integrated opto-electronics into photonic crystals and plasmonics is reviewed, with an emphasis on the specific cases of miniaturized lasers, plasmonic light emitters and silicon photonics. See the "Conference Highlights" section in the front of the book for more information on Axel Scherer, including a photo.

IMA2 • 10:40 a.m.

Development of Subwavelength Structure Coating (SWC) and Its Application to Imaging Lenses, Takeharu Okuno; Canon Inc., Japan. We have developed a high performance anti-reflection coating with subwavelength structures. The principle and characteristics of the new anti-reflection coating as well as its application to imaging lenses are reported.

IMA3 • 10:55 a.m. Invited

The Power of Negative Thinking, David Shafer; David Shafer Optical Design, USA. In a highly corrected design the limiting aberrations are induced ones, not intrinsic. Their causes are explained, and some simple designs are shown which eliminate these aberrations. These designs have more negative lenses than usual.

OMA • Interferometry

Monday, June 14

10:00 a.m.–12:30 p.m.

James Burge; College of Optical Sciences, Univ. of Arizona, USA, Presider

OMA1 • 10:00 a.m. Invited

Instantaneous Interferometry: Another View, Daniel M. Sykora, Peter de Groot; Zygo Corp., USA. Single-camera frame instantaneous interferometry is an alternative optical test method where environmental noise prohibits conventional phase shifting methods. The flexibility and high performance of an optimized spatial carrier fringe method provides a compelling solution.

OMA2 • 10:30 a.m.

A Toolbox for Designing and Analyzing Phase-Shifting Interferometry Algorithms with Characteristic Polynomials, Ulf Griesmann; Manufacturing Engineering Lab, NIST, USA. Many recent advances in understanding of phase-shifting algorithms have yet to be incorporated into commercial phase-shifting interferometry software. A toolbox, for the open-source computer algebra system Maxima, simplifies analysis and design of arbitrary phase-shifting algorithms.

OMA3 • 10:45 a.m.

Diffraction Effects in Interferometry, Ping Zhou, James Burge; College of Optical Sciences, Univ. of Arizona, USA. Besides the geometrical errors, interferometry suffers errors due to diffraction, because the wavefront aberrations of the test and reference beams change as they propagate. This paper addresses errors due to diffraction effects in interferometry.

OMA4 • 11:00 a.m.

Step Height Measurement Using a Wavelength-Selective Multimode Laser Diode, Takamasa Suzuki, Akihiro Nomura, Osami Sasaki; Niigata Univ., Japan. A wavelength-selective interferometer based on the multimode oscillation of a laser diode is proposed and is used to conduct step height measurements. A selective spectrum allows us to generate a wide range of synthetic wavelengths.

IMA • Surface Plasmons Plenary, Emerging Technologies and
Fundamental Optical Design, and Kidger and Hilbert Award
Presentations—Continued

OMA • Interferometry—Continued

IMA4 • 11:25 a.m. Invited

Sixth-Order Wavefront Deformations: The Coefficients and Insights into Wavefront Propagation in Optical Systems, Jose Sasian; *College of Optical Sciences, Univ. of Arizona, USA*. The oral presentation of this paper provides historical remarks on the development of aberration theory and discusses the topic of sixth-order wavefront aberrations. We present some insights on wavefront propagation and deformation in optical systems.

11:55 a.m.

Michael Kidger Memorial Scholarship Presentation

The Michael Kidger Memorial Scholarship was established in 1998 to honor Michael John Kidger, a well-respected educator, design software developer and member of the optical science and engineering community. A full description can be found online at www.kidger.com. Tina Kidger will present a short review of the establishment and organization of the Scholarship and a brief update on the ten Kidger Scholarship awardees to date. She will then present the award to this year's Awardee, *Braulio Fonseca Carneiro de Albuquerque, Natl. Inst. for Space Research, São Paulo, Brazil*.

12:10 p.m.

Robert S. Hilbert Memorial Student Travel Grant Presentation

The Robert S. Hilbert Memorial Student Travel Grant offers financial support to help defray the cost of student travel to the International Optical Design Conference (IODC), Frontiers in Optics (OSA's Annual Meeting) and other professional meetings. The grant was established in honor of Bob S. Hilbert (1941–2008), former Optical Research Associates (ORA®) President and CEO, who was a respected member of the optics community and enthusiastically embraced learning and optics education. The grant is sponsored by ORA, and administered by OSA Foundation.

OMA5 • 11:15 a.m. Invited

Stitching Interferometry—The Long and Winding Road... Michael Bray; *MBO-Metrology, France*. We will present the early history of the world's first *commercial* stitching interferometer, difficulties encountered and how we solved them, and interesting facts gathered along the road leading to our present involvement in stitching interferometry.

OMA6 • 11:45 a.m.

An Iterative Tilt-Immune Phase-Shifting Algorithm, Bo-Jhih Lin¹, *Yi-Chun Chen*¹, *Chung-Min Lee*^{2,3}, *Chao-Wen Liang*¹; ¹*Dept. of Optics and Photonics, Natl. Central Univ., Taiwan*, ²*Dept. of Mathematics and Statistics, California State Univ. Long Beach, USA*, ³*School of Science and Engineering, Reykjavik Univ., Iceland*. An iterative least-squares-based phase-shifting algorithm was developed to cope with random pistons and tilts from the phase shifter. The allowable tilt amount was 0.5 waves over the pupil. The achieved rms accuracy was 0.0024 radians.

OMA7 • 12:00 p.m.

Student Award Participant

Interferometer Calibration Using the Random Ball Test, Wenrui Cai, *Dae Wook Kim, Ping Zhou, Robert E. Parks, James H. Burge*; *College of Optical Sciences, Univ. of Arizona, USA*. Two different approaches (systematically and randomly rotating the CaliBall™ to calibrate a Fizeau interferometer transmission sphere) are demonstrated with similar calibration results. Thus, the random approach is preferred as a quicker and easier measurement procedure.

OMA8 • 12:15 p.m.

Variable Null Optics for Subaperture Stitching of Aspheres, Paul E. Murphy, *Greg Forbes, Andrew Kulawiec*; *QED Technologies, USA*.

Aspheres are often tested with null optics, but these are usually specific to the asphere prescription. We present a variable null system suitable for flexible asphere testing when employed with subaperture stitching.

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

IMB • Illumination Engineering: Principles and Practice

Monday, June 14
2:00 p.m.–4:00 p.m.
R. John Koshel; Photon Engineering LLC and College of Optical Sciences, Univ. of Arizona, USA, Presider

IMB1 • 2:00 p.m. Invited

A Practical and Predictive Two-Metric System for Characterizing the Color Rendering Properties of Light Sources for Architectural Applications, *Mark S. Rea; Lighting Res. Ctr., Rensselaer Polytechnic Inst., USA*. Two convenient metrics, color rendering index (CRI), the industry standard, and gamut area index (GAI) can be used successfully together, but not separately, to characterize the color rendering properties of electric light sources.

IMB2 • 2:30 p.m. Invited

From Enthusiasm to Economy: Precision Optical Design as a Key to Making LED Luminaires Cost-Efficient in Street Lighting and Architectural Lighting, *Andreas Timinger; OEC AG, Germany*. Technical luminaires have to compete on an economic basis. Optics design plays a key role for the development of efficient products, providing unique light distributions and minimizing the total costs of ownership.

IMB3 • 3:00 p.m. Invited

Non-Visual Effects of Light: Implications for Design, *Mariana Figueiro; Lighting Res. Ctr., Rensselaer Polytechnic Inst., USA*. Light isn't just for vision anymore! Illumination design should consider the needs of the visual and non-visual systems. Discussed are the lighting characteristics impacting these two systems and the implications for designing light for architecture.

IMB4 • 3:30 p.m. Invited

Primary Optics for LEDs—State of the Art of Optical Architectures, *Julius A. Muschaweckl, Peter Brickl, Stefan Grötsch, Simon Schwalenberg²; ¹OSRAM Opto Semiconductors, Germany, ²OSRAM GmbH, Germany*. Good primary optics for LEDs are crucial for applications working technically and economically. But what is “good”? For various optical architectures, we look at the complex interplay between optics, manufacturing, tolerancing, lifetime and cost.

OMB • Metrology

Monday, June 14
2:00 p.m.–4:00 p.m.
Shai Shafrir; OptiPro Systems, Inc., USA, Presider

OMB1 • 2:00 p.m. Invited

Introduction to Surface Finish Metrology, *Theodore Vorburger; NIST, USA*. A number of methods are available to measure surface finish; methods of stylus profiling and optical profiling are emphasized here. Documentary standards for measurement of surface texture and comparisons between methods are also discussed.

OMB2 • 2:30 p.m.

Predicting Image Degradation from Optical Surface Metrology Data, *James E. Harvey¹, Narak Choi¹, Andrey Krywonos¹, Gary Peterson²; ¹CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, ²Breault Res. Organization, USA*. A generalization of Peterson's surface scatter model results in an improved capability to predict image degradation from optical surface metrology data. A new surface scatter theory for moderately rough surfaces provides the necessary BSDF data.

OMB3 • 2:45 p.m. Invited

Clash of Cultures: Uncertainty vs. Accuracy, *Chris Evans; Zygo Corp., USA*. Accuracy of measurement is desirable but, by definition, cannot be quantified. ISO gives a formalism for evaluating uncertainty, combining information from many sources, and providing a guard-band for deciding if an optic meets specification.

OMB4 • 3:15 p.m.

Student Award Participant

Fast Optical Profiler, *Takeshi Nakazawa¹, Jose Sasian¹, Francy Abraham²; ¹College of Optical Sciences, Univ. of Arizona, USA, ²Intel Corp., USA*. We present the optical design of a fast single shot profiler. A depth resolution of 0.6 micrometer RMS was achieved in an area of 1.2x0.9 mm with a 0.5 second data acquisition time.

OMB5 • 3:30 p.m. Invited

Pixel-Based Computations in Optical Metrology, *William P. Kuhn; Opt-E, USA*. Two examples of large, pixel based computations are described: calibration of an interferometer, and stitching of interferometry data. A simple calculation performed inefficiently is also presented to remind one to thoughtful in your approach.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby

IMC • Optical Surface Representation and Freeform Design

Monday, June 14
4:30 p.m.–6:00 p.m.
Scott A. Lerner; Hewlett Packard, USA, Presider

IMC1 • 4:30 p.m. Invited

Application of Radial Basis Functions to Represent Optical Free-Form Surfaces, *Ozan Cakmakci*¹, *Ilhan Kaya*², *Gregory E. Fasshauer*³, *Kevin P. Thompson*¹, *Jannick P. Rolland*³; ¹*Optical Res. Associates, USA*, ²*Univ. of Central Florida, USA*, ³*Inst. of Optics, Univ. of Rochester, USA*. This paper presents the use of radial basis functions (RBF) for describing freeform optical surfaces. The RBF approximation framework along with preliminary optical design experiences will be summarized.

IMC2 • 5:00 p.m.
A Comparison of Anamorphic and Keystone-Distorted Surface Types for Aberration Correction, *John R. Rogers*; *Optical Res. Associates, USA*. Adding keystone distortion, in addition to anamorphism, to an off-axis asphere dramatically improves the ability of the surface to correct aberrations.

IMC3 • 5:15 p.m. Student Award Participant

A New Generation of Optical Systems with Theta-Polynomial Surfaces, *Kyle H. Fuerschbach*¹, *Kevin P. Thompson*², *Jannick P. Rolland*¹; ¹*Inst. of Optics, Univ. of Rochester, USA*, ²*Optical Res. Associates, USA*. Recent advances have made it viable to fabricate optical surfaces that are not rotationally symmetric using a new generation of diamond-turning machines. These surfaces can greatly extend the field of view of optical systems.

IMC4 • 5:30 p.m. Invited

Large Field-of-View and High Resolution Free-Form Head-Mounted Display, *Dewen Cheng*^{1,2}, *Yongtian Wang*¹, *Hong Hua*²; ¹*Dept. of Optoelectronic Engineering, Beijing Inst. of Technology, China*, ²*3D Visualization and Imaging Systems Lab, College of Optical Sciences, Univ. of Arizona, USA*. An eyepiece based on a wedge-shaped free-form prism is successfully designed and developed. The tiling HMDs with wide angle and reasonable resolution using the prism eyepieces are proposed and discussed. One prototype result is presented.

OMC • Optical Materials

Monday, June 14
4:30 p.m.–6:00 p.m.
Tayyab Suratwala; Lawrence Livermore Natl. Lab, USA, Presider

OMC1 • 4:30 p.m. Invited

Chalcogenide Glasses: Their Unique Functionalities for Present and Potential Applications in Photonics, *Miroslav Vlcek*¹, *Himanshu Jain*^{2,3}; ¹*Faculty of Chemical Technology, Univ. of Pardubice, Czech Republic*, ²*Ctr. for Optical Technologies, Lehigh Univ., USA*, ³*Intl. Materials Inst. on New Functionality in Glass, Lehigh Univ., USA*. Paper reviews unique properties and functionalities of chalcogenide glasses for photonic applications. We demonstrate their applications in extremely high-resolution lithography and for fabrication of diffractive elements. All-optical signal processing applications are discussed as well.

OMC2 • 5:00 p.m.
Distribution of the Coefficient of Thermal Expansion on CEARCERAM®-Z HS from Surface Deformation Measurement Approach, *Kousuke Nakajima*, *Nobuo Kawasaki, Tomokazu Morita; OHARA Inc., Japan*. The CTE distribution on CLEARCERAM®-Z HS was determined by surface deformation measurement approach. The result is compared with the one from a sampling procedure and the intuitive CTE distribution on the material is discussed.

OMC3 • 5:15 p.m. Student Award Participant

Thermal Shock During Cooling/Rinsing of Optical Glass, *Han Liu*, *Daniel Breyre, Robin Hargadon, Justin Long, John C. Lambropoulos; Univ. of Rochester, USA*. We measured thermal shock strength degradation of BK-7 glass versus surface finish, in water and silicone oil. There is little strength degradation prior to fracture. Retained strength depends on surface finish and cooling medium.

OMC4 • 5:30 p.m. Invited

An Overview of the Maturation of SiC Optics Fab, *Joseph Robichaud*; *L-3 Communications, SSG-Tinsley, USA*. L-3 SSG has been developing SiC optical systems for space-based applications for >20 years. Over this time significant advances have been made in SiC manufacturing. We provide data which illustrates the maturation of this technology.

JMB1

New Variance-Reducing Methods for the PSD Analysis of Large Optical Surfaces, Erkin Sidick; JPL, USA. We present two new methods for reducing variance in PSD data by replacing the zeros of a surface map by non-zero values obtained from a PSD fit or taken from inside of its circular area.

JMB2

Student Award Participant

Modifying the Rheological Properties of Zirconia Coated Carbonyl Iron Suspensions through Acid-Base Titration and the Addition of Di-Ammonium Citrate, Michael D. Skarlinski^{1,2}, Stephen D. Jacobs²; ¹Dept. of Mechanical Engineering, Univ. of Rochester, USA, ²Lab for Laser Energetics, Univ. of Rochester, USA. The manipulation of surface chemistry through acid-base titration and the addition of DAC as a surfactant are shown to lower viscosity in several compositions of zirconia coated carbonyl iron suspensions, used in magnetorheological finishing.

JMB3

Overview of Optical Metrology Capabilities for the National Ignition Facility, Michael J. Runkel; Lawrence Livermore Natl. Lab, USA. Optics fabrication for the National Ignition Facility has required developing, fielding and maintaining over 30 large-aperture metrology systems with a broad range of measurement capabilities. An overview of these systems' capabilities will be given.

JMB4

A Contactless Method for Characterization of Diffusers for Coherent Noise Reduction, Shiguang Wang; Zygo Corp., USA. Coherent noise reduction in interferometers often involves a rotating diffuser. This paper describes technical details about a contactless method for characterizing and optimizing diffusers based on measuring scattered light in spatial frequency domain.

JMB5

Student Award Participant

Demonstration of a Small Robust Carbon Fiber Mirror with Low Surface Error Suitable for Near-Infrared Astronomy, Blake Coughenour¹, S. Mark Ammons², Michael Hart², Hop Bailey², Matt Rademacher², Robert Martin³, Robert Romeo³; ¹College of Optical Sciences, Univ. of Arizona, USA, ²Steward Observatory, Univ. of Arizona, USA, ³Composite Mirror Applications, USA. Carbon fiber reinforced polymer (CFRP) composite mirror created using new fabrication techniques is tested under actuation. Surface errors are found to be 82nm RMS of the relaxed surface, and 43nm RMS under best actuator correction.

JMB6

Grinding of Aluminum Mold Using a Rectangular Tool Controlled by an XYZ Machine, Fermin Granados-Agustín, Elizabeth Percino-Zacarias, Irce Leal Cabrera; INAOE, Mexico. In this paper, it is described the grinding process for an aluminum mold using and XYZ polishing machine to move the center of a rectangular tool. Experimental and calculated wear profiles are compared.

JMB7

Hartmann Null Screen with Drop Shape Spots for Measure the Spherical Aberration in a Plane-Convex Lens, Maximino Avendaño-Alejo, Dulce González-Utrera, Rufino Díaz-Urbe; Univ. Nacional Autónoma de México, Mexico. A new Hartmann null screens for a better alignment and centroid evaluation to test a plane-convex spherical lens is presented. The designs of these screens are based on the knowledge of the caustic by refraction.

JMB8

Testing a Small Aspheric Lens by Reflective Null CGH, Dae-Chan Kim¹, Ho-Youl Lee¹, Hyun-Jun Jang², Ook-Hee Lee², Jong-Sub Song², Jong Ung Lee³, Beom-Hoan O¹, Se-Geun Park¹, El-Hang Lee¹, Seung Gol Lee¹; ¹Inha Univ., Republic of Korea, ²Samsung Electro-Mechanics Automation Group, Korea, Republic of, ³Laser & Optical Information Engineering, Cheongju Univ., Republic of Korea. A null CGH for compensating a small aspheric lens is designed to make the testing configuration simple and fabricated. Peak-to-valleys and rms heights of aspheric lenses are measured to be 0.270 and 0.040 waves, respectively.

JMB9

Parallel Point Diffraction Interferometer (PDI) and Shack-Hartmann Sensor (SHS) for Simultaneous Testing of an Optical System, Perla C. Garcia-Flores, Jose R. Diaz-Urbe; UNAM-CCADET, Mexico. An optical setup with a PDI and a SHS in parallel for simultaneously testing the same optical system is proposed. This allows a simple comparison of the results obtained with both methods.

JMB10

Student Award Participant

Quality Testing of Diamond-Abrasive, Metal-Bond Grinding Tool Materials, Christopher D. Roll, Brian E. MacMillin, Paul Funkenbusch; Dept. of Mechanical Engineering, Univ. of Rochester, USA. Metal-bond tool materials, with a variety of bonds and diamond compositions, have been characterized mechanically and examined microscopically. The results illustrate the potential use of such testing to track quality, consistency, and predictability related concerns.

JMB11

Student Award Participant

Effects of Bond Hardness and Diamond Concentration on the Erosion of Diamond Tool Materials, Christopher D. Roll, Brian E. MacMillin, Paul Funkenbusch; Dept. of Mechanical Engineering, Univ. of Rochester, USA. Erosion of the tool material during deterministic microgrinding is essential to produce self-sharpening. In this study the effect of bond hardness and diamond size on the erosion of bronze-bond, diamond-abrasive tool materials is reported.

JMB12

Controlled Edge Damage by Dynamic Impact, Matthew L. Black, Don A. Clark, G. Scott Glaesemann; Corning Inc., USA. Mechanical contact with glass substrates can induce visible and strength limiting damage. Glass edges are especially susceptible to such damage. Dynamic impact with a glass edge will likely produce classic sharp crack signatures.

JMB13

Complex Surface Measurement by Non-Contact Probes, Scott DeFisher, Shai Shafrir; OptiPro Systems, USA. UltraSurf is a five axis non-contact optical 3-D scanner for the measurement of complex optical surfaces. Interchangeable optical probes enable non-contact surface and thickness measurements of surfaces of ground or polished parts.

JMB14

Optical Testing of a Reflective Cone With a Null Screen, Rufino Díaz-Urbe¹, Maximino Avendaño-Alejo¹, Perla C. Garcia-Flores¹, Luis M. Arredondo-Vega², Carlos Pérez-Santos²; ¹Univ. Nacional Autónoma de México, Mexico, ²Cent. de Investigaciones en Óptica, Mexico. The design of a cylindrical null screen with its axis of symmetry parallel to the optical axis of the surface of the test cone is described. The optical setup and experimental results are presented.

JMB15

Chabot Observatory's Leah and Rachel: The Results of Modern Testing on 8 Inch (1883) and 20 Inch (1914) Refracting Telescopes, Robert E. Schalck; Hardin Optical Co., USA. We describe a unique opportunity to test two antique refracting telescopes using interferometers and the surprising results that they meet modern standards in terms of optical performance.

JMB16

Aspheres in a Double Gauss: Rehashing an Old Study, Scott Sparrold; Edmund Optics, USA. Aspheric placement in the Double Gauss form is re-evaluated. Several asphere placements are considered and their resulting aberration balances are studied. Conclusions about the utility and use of inflection aspheres are included.

JMB17

Simulation as a Tool for Teaching Spectrographs Optics to Undergraduate Physics Students, Guillermo E. Baldwin, Rubén Sánchez, Miguel Asmad, Karem Tucto, Franco Gonzales; Pontificia Univ. Católica del Perú, Peru. It is shown how undergraduate physics students were introduced to spectrographs optics through simulations. Evaluations of two equivalent theoretical spectrographs and a real commercial spectrograph are performed. A comparative work on spectrographs resolution is made.

JMB18

The Optics Toolkit at NASA's Goddard Space Flight Center, Joseph Howard; NASA Goddard Space Flight Ctr., USA. Analysis beyond the traditional design metrics such as spot size or wavefront variance is generally needed to address mission requirements for NASA. The Optics Toolkit is used with optical design software to complete these tasks.

JMB19

Optical Kit for Training Students in Lens Design, Irina L. Livshits, Vladimir N. Vasilyev, Sergey K. Stafeev, Matvey A. Pashkovskiy; Engineering Ctr. OPTICA, Saint Petersburg State Univ. of Information Technologies, Mechanics and Optics, Russian Federation. Educating optical designers is a very important part of the job at optical-related universities. Our optical design kit gives students practical skills and inspiration and allows them to have fun and enjoy becoming optical designers.

JMB20

The Design of a Binocular Visual System of Long Eye Relief Using a Freeform Profile, Xuemin Cheng^{1,2}, Jianshe Ma^{1,2}, Liangjun Chen^{1,2}; ¹Graduate School at Shenzhen, Tsinghua Univ., China, ²Dept. of Precision Instruments, Tsinghua Univ., China. The design of a binocular visual system of long eye relief using a freeform profile is investigated in this paper. It provides a virtual enlarged image and is used for early diagnosis of eye problem.

JMB21

Student Award Participant

Sunlight and LED Hybrid Illumination in Indoor Lighting Design, Wen-Shing Sun, Chih-Hsuan Tsuei; Dept. of Optics and Photonics, Natl. Central Univ., Taiwan. We design a light integrating collector that can collect the sunlight and LED light to illuminate the indoor spaces uniformly, and then use in simulating the sunlight/LED hybrid illumination at daytime, LED lighting at nighttime.

JMB22

MLA Fiber Injection for a Square Core Fiber Optic Beam Delivery System: Design versus Prototype Results, Todd Lizotte¹, Fred Dickey²; ¹Hitachi Via Mechanics Inc., USA, ²FMD Consulting, USA. We detail a square core fiber beam delivery design utilizing a unique micro lens array launch

method, and resulting performance of a prototype created to verify the design and its stability.

JMB23

A Study of Thin Profile Solar Concentrators Using Wedge Prism with Diffractive Grating, Tanant Waritanant¹, Sakoolkan Boonruang², Te-yuan Chung³; ¹Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, ²Photonics Technology Lab, Natl. Electronics and Computer Technology Ctr. (NECTEC), Thailand. Solar concentrators using wedge prism with diffractive grating or sawtooth profile mirror are proposed and studied. The concentrator length-to-thickness ratio can exceed 6 and the maximum concentration ratios exceed 3.5 for these designs.

JMB24

Miniaturized UV Fluorescence Collection Optics Integrated with Ion Trap Chips, Gregory R. Brady, Shanalyn A. Kemme, A. Robert Ellis; Sandia Natl. Labs, USA. For practical quantum computing, it will be necessary to detect the fluorescence from many trapped ions. We describe a design and integration approach using micro-optics to couple this fluorescence into an array of optical fibers.

JMB25

The First Order Optics of Novel Testing Equipment for Compact Camera Module, Jui-Wen Pan; Inst. of Photonic System, Natl. Chiao Tung Univ., Taiwan. We proposed a concept to improve the examining equipment for adjusting the back focal length of compact camera module (CCM). The volume of this equipment was reduced to 1% and examining speed was significantly improved.

JMB26

New Modeling and Algorithms Development on Local and Global System Optimization, Quanxin Ding, Hua Liu; Luoyang Inst. of Electro-optical Equipment of AVIC, China. To exert advantages of optimization methods for upgrade innovation, the relationship among Model Parameterization, Optimization Algorithm and Merit Function is defined. Some optimization strategies are discussed. Multiple typical results demonstrate validity and potential new challenges.

JMB27

Strategies on Catadioptric, Refractive with Diffractive Configurations, Quanxin Ding, Hua Liu; Luoyang Inst. of Electro-optical Equipment of AVIC, China. Strategies satisfies applied requirements on some criterion, such as MTF, RMS, PSF, utilized cost, test plate matching, fabrication feasibility and so on, achieves remarkable advantages in system efficiency. New concept and algorithm is developed.

JMB28

ABCD Matrix for Calculating Third-Order Aberrations Gradient Index Optical Elements, Francisco Sorroche¹, José A. Díaz¹, José Fernández-Dorado², Josep Arasa³; ¹Univ. de Granada, Spain, ²SnellOptics, Spain, ³Univ. Politècnica de Catalunya, Spain. This work presents the use of the ABCD matrix for obtaining the Seidel third-order aberration coefficients, i.e. contribution of GRIN to surface refraction and transfer, for each individual surface of GRIN optical elements.

JMB29

Student Award Participant

Three-Dimensional Polarization Ray Tracing and Diattenuation Calculation, Garam Yun, Karlton Crabtree, Russell Chipman; College of Optical Sciences, Univ. of Arizona, USA. A three-by-three polarization ray tracing matrix **P** for calculating polarization transformations associated with ray paths through optical systems is presented. Diattenuation of the optical system is calculated via singular value decomposition of the **P** matrix.

JMB30

Student Award Participant

Two Figures of Merit for Fast Estimating Tolerance Sensitivity in Lens Systems, Lirong Wang, Jose M. Sasián; College of Optical Sciences, Univ. of Arizona, USA. We propose two parameters CS and AS for fast estimating sensitivities to constant coma and linear astigmatism in misaligned lens system. We show that the figures correlate well with actual tolerancing of some lens systems.

JMB31

Mobile Phone Camera Lens Design with Reduced Flare, Xi Chen; Aptina Imaging, USA. Flare due to total internal reflection (TIR) from optical surfaces in a mobile phone camera is analyzed. An optimization method for lens design to reduce TIR flare is proposed and described.

JMB32

Development of Wide-Angle Three-Mirror System with Spiral Optical Axis, Takayuki Nakano, Yoshihiro Matsumoto, Yasuhisa Tamagawa; Mitsubishi Electric Corp., Japan. A design method of wide-angle three-mirror system with spiral optical axis is proposed. An example system of F/2 and 30x24 degrees field-of-view is designed and fabricated for infrared imaging applications.

JMB33

Illustrating Method of Triplet Prisms for Minimizing the Chromatic Aberration, Wen-Shing Sun; Dept. of Optics and Photonics, Natl. Central Univ., Taiwan. We present an illustrating method for triplet prisms combination that can minimize the chromatic aberration. The apochromatic aberration equation, relation between relative partial dispersion and glass V-number can be quickly analyzed and found the combination.

JMB34

Wide Band Application of Holographic Lenses for Photovoltaic Power Generation, *Abhijit Ghosh, Rajeev Ranjan, Hira Lal Yadav*; Natl. Inst. of Technology, Jamshedpur, India. This paper reveals that low film thickness and high refractive index modulation are quite promising for achieving broad band operation and high diffraction efficiency over the entire useful solar spectrum for designing holographic concentrators.

JMB35

Student Award Participant

Design of Multichannel Optical Tomography System, *J. B. Jeeva¹, Megha Singh^{1,2}*; ¹VIT Univ., India, ²SGNE Foundation, India. A 32-channel optical tomography system designed provides 3-D projection data of an object. The system consists of laser diode source and photodiode detectors. From the 3-D data, tomographic slices of tissue equivalent phantom are obtained.

JMB36

Review of a High Resolution Catadioptric Optics Module, *Nathalie Blanchard*, *Nichola Desnoyers, Anne Martel, Mathieu Demers, Bruno Tremblay, Loïc Le Noc, Claude Chevalier, Alain Bergeron*; INO, Canada. A 1280x960 pixel high resolution catadioptric optics module with an effective f-number of F/1.05 and a total field of view of 22.6 degrees is presented.

JMB37

Anamorphic Eyepiece for Increased Field of View, *Sean A. Moore*; US Army RDECOM CERDEC Night Vision and Electronic Sensors Directorate, USA. An innovative design for an anamorphic eyepiece is described, which uses a microlens array with complicated surface features used with a modified microdisplay to provide a high resolution image with a panoramic field of view.

JMB38

Diffraction Null Lens for Parabolic Mirrors, *Omar Garcia-Liévanos¹, Sergio Vazquez-Montiel²*; ¹IPN, Mexico, ²INAOE, Mexico. The phase coefficients control the diffracted ray, this travels through of the normal to the aspheric surface. The spherical and coma aberrations are corrected and the optimization process is not required.

JMB39

Surface Evaluation with Ronchi Test by Using Malacara Formula, Genetic Algorithms and Cubic Splines, *Alberto Cordero-Dávila¹, Jorge González-García²*; ¹Posgrado en Física Aplicada, Benemerita Univ. Autónoma de Puebla BUAP, Mexico, ²Univ. Tecnológica de la Mixteca UTM, Mexico. In Ronchi test Malacara formula is used to evaluate surface errors, which are represented by cubic splines. The spline coefficients are estimated by means of genetic algorithms.

JMB40

Optical Design and Analysis of a Tunable Focus Liquid Lens with Meniscus Surfaces, *Agustín Santiago-Alvarado¹, Sergio Vázquez-Montiel², Fernando Iturbide-Jiménez³*; ¹Univ. Tecnológica de la Mixteca, Mexico, ²Inst. Nacional de Astrofísica, Óptica y Electrónica, Mexico. In this work, we present the optical design of a tunable focus liquid lens composed with meniscus surfaces. The surfaces are elaborated of PDMS. Analysis of the opto-mechanical behavior of the lens is presented.

JMB41

Optical Design for the Submillimeter and Far InfraRed Experiment (SAFIRE), *Bert Pasquale¹, Dominic Benford¹, George Voellmer¹, S. Harvey Moseley¹, Peter Steigner²*; ¹NASA Goddard Space Flight Ctr., USA, ²Bastion Technologies, Inc., USA. SAFIRE, the Submillimeter and Far InfraRed Experiment, was designed for interstellar physics in the airborne Observatory SOFIA. SAFIRE is a cryogenic Echelle Grating spectrograph for covering 120 to 470 microns, with R ranging from 2-12,000.

JMB42

Optical Design for the Composite InfraRed Spectrometer Lite (CIRS-Lite), *Bert Pasquale, John Brasunas, John Hagopian, Qian Gong*; NASA Goddard Space Flight Ctr., USA. Following up on Cassini/CIRS, we are building the next-generation Composite InfraRed Spectrometer for deep-space planetary exploration. CIRS-Lite combines Mid & Far-IR channels into a single instrument with 4x the spectral sensitivity.

JMB43

Design of a CGH Corrected Calibration Objective for the AO System at the Large Binocular Telescope, *Christian Schwab¹, Diethard Peter², Simon Aigner³*; ¹Landessternwarte-ZAH, Univ. Heidelberg, Germany, ²Max-Planck Inst. for Astronomy, Germany, ³Dioptric GmbH, Germany. We describe the optical design of a calibration unit for the off-axis laser guide stars at the Large Binocular Telescope's ARGOS facility. Artificial stars with the desired wavefront are created using a computer generated hologram.

Tuesday, June 15, 7:30 a.m.–6:00 p.m. Registration Open, Lobby

ITuA • Optical Systems I: Telescopes, Binoculars and Reflective Systems

Tuesday, June 15

8:00 a.m.–10:00 a.m.

Jannick P. Rolland; Inst. of Optics, Univ. of Rochester, USA, Presider

ITuA1 • 8:00 a.m.

Comparative Concepts for ATLAST Optical Designs, Bert A. Pasquale¹, Philip Stahl², Lee Feinberg¹, Joseph Howard¹, Qian Gong¹, David Aronstein¹; ¹NASA Goddard Space Flight Ctr., USA, ²NASA Marshall Space Flight Ctr., USA. The ATALST (Advanced Technology for Large Aperture Space Telescopes) effort has presented several design incarnations. Here we will compare the 9.2m segmented, the 8m monolithic on-axis and 8m x 6m off-axis concepts.

ITuA2 • 8:15 a.m.

Simultaneous Design of an Optical System and Null Tests of the Components: Examples and Results from the Large-Aperture Synoptic Survey Telescope, Lynn G. Seppala; Lawrence Livermore Natl. Lab, USA. Optical null tests for three lenses and two subsystems were incorporated into the optical design procedure for the Large-aperture Synoptic Survey Telescope. The “skip surfaces” feature in the OSLO optical design program was crucial.

ITuA3 • 8:30 a.m.

Invited

The 300-Year Quest for Binoculars, John Greivenkamp, David Steed; College of Optical Sciences, Univ. of Arizona, USA. The modern form of the refracting telescope advanced rapidly following its invention in 1608, but almost 300-years elapsed before practical prismatic binoculars become available. The evolution of binoculars and the associated manufacturing issues are discussed.

ITuA4 • 9:00 a.m.

Withdrawn

OTuA • Specification and Measurement

Tuesday, June 15

8:00 a.m.–10:00 a.m.

Damon W. Diehl; ASE Optics, Inc., USA, Presider

OTuA1 • 8:00 a.m.

Invited

International Standards for Optics in the Electronic Age, Prudence M. J. H. Wormell; Imperial College, UK. The Concept DataBase being developed by International Organization for Standardization originated in a project of the Technical Committee for Optics and Photonics. It pioneers universally accepted standards online, available to industries worldwide to benefit trade.

OTuA2 • 8:30 a.m.

The Truth about Scratch and Dig, David M. Aikens; Savvy Optics Corp., USA. Surface imperfection specifications (i.e. Scratch-Dig) are the most misunderstood, misinterpreted, and ambiguous of all optics component specifications. It is time to de-mystify this problematic specification once and for all.

OTuA3 • 8:45 a.m.

Student Award Participant

Simultaneous Measurement of the Full-Field Aberration, Chao-Wen Liang, Pen-I Liao; Natl. Central Univ., Taiwan. A modified grating-slit test is shown to measure the full-field aberration at multi fields simultaneously by adding a slit-lens matching array. Experimental results shows sensitivity to observe changing off-axis aberration of a tilt lens.

OTuA4 • 9:00 a.m.

Characterization of an Alignment Procedure Using an Air Bearing and Off-the-Shelf Optics, Matt Dubin, Laura E. Coyle, James H. Burge; College of Optical Sciences, Univ. of Arizona, USA. We demonstrate that using a simple telescope mounted on a high quality bearing can yield comparable or lower uncertainty than an alignment telescope for the centering of elements in an optical system.

ITuA • Optical Systems I: Telescopes, Binoculars and Reflective Systems—Continued

ITuA5 • 9:15 a.m.

Anamorphic Imaging with Three Conic Mirrors, Joseph M. Howard¹, Bryan D. Stone^{2,3}; ¹NASA Goddard Space Flight Ctr., USA, ²Inst. of Optics, Univ. of Rochester, USA, ³Optical Res. Associates, USA. Design methods are described for unobstructed, plane-symmetric systems composed of three conic mirrors. Low order imaging constraints (without the requirement of nonanamorphism) are used to reduce the dimensionality of the configuration space. Examples are presented.

ITuA6 • 9:30 a.m.

Student Award Participant

All-Spherical Catadioptric System for 0.8 m F/4.5 Astronomical Telescope: Can We Compete with the Ritchey-Chrétien Design? Mehdi Bahrami, Alexander V. Goncharov, Christopher Dainty; Natl. Univ. of Ireland, Galway, Ireland. Aspherical surfaces are difficult to manufacture; therefore we consider a possibility of using only spherical surfaces. Two optical designs for 800-mm F/4.5 seeing limited telescope are considered: Ritchey-Chrétien and a two-mirror Catadioptric system.

ITuA7 • 9:45 a.m.

A Family of 2 Mirror Unobscured Wide Field Telescope and Collimator Designs, Richard F. Horton; ad hoc Optics LLC, USA. A new family of 2 mirror unobscured telescopes of “Schiefspiegler” geometry, using aspheres, tilts and decenters, will serve as fast, high resolution, wide field telescopes/collimators. Examples will be described and compared to other designs.

OTuA • Specification and Measurement—Continued

OTuA5 • 9:15 a.m.

Roughness Measurement of Ultra Precision Surfaces using Light Scattering Techniques and Analysis, Tobias Herffurth, Sven Schröder, Marcus Trost, Angela Duparré; Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany. Light scattering techniques are used as powerful method for roughness measurements. Recent achievements in characterizing even large and curved surfaces are presented.

OTuA6 • 9:30 a.m.

Invited

The Forbes Polynomial: A More Predictable Surface for Fabricators, Kevin P. Thompson¹, Florian Fournier², Jannick P. Rolland², G. W. Forbes³; ¹Optical Res. Associates, USA, ²Inst. of Optics, Univ. of Rochester, USA, ³QED Technologies, Inc., USA. The Forbes polynomial is an important new surface type that allows coefficient tolerances to be meaningful and allows the difficulty of fabrication to be quantified. Implications and guidance to fabricators will be presented.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby

10:00 a.m.–4:30 a.m. Exhibits Open, Mezzanine-Grand/Lobby

NOTES

ITuB • Optical Design for Modern Digital Systems and Computational Imaging

Tuesday, June 15

10:30 a.m.–12:15 p.m.

David M. Hasenauer; Optical Res. Associates, USA, Presider

ITuB1 • 10:30 a.m.

Thru Focus MTF Optimization in Lens Design, Rob Bates; FiveFocal LLC, USA. A method of optimization using the thru-focus MTF is described. Operands based on the peak and distance from the evaluation plane to the peak are investigated for their insensitivity to local minima in DLS optimization.

ITuB2 • 10:45 a.m.

Fast Interpolation-Based Quality Evaluation for Digital-Optical System Optimization, Michael D. Robinson, Kathrin Berkner; Ricoh Innovations, USA. We describe a computationally-efficient approach to approximate the end-to-end MSE merit function for evaluating and optimizing digital-optical imaging systems based on interpolation. We use commercial lens design software to verify the approach.

ITuB3 • 11:00 a.m.

Invited

Light Field Photography, Microscopy and Illumination, Marc Levoy; Stanford Univ., USA. Light fields represent radiance as a function of position and direction in space. I describe three systems for recording and generating light fields: a camera array, a handheld plenoptic camera, and a light field microscope.

ITuB4 • 11:30 a.m.

Student Award Participant

Fidelity Comparison of Phase Masks for Hybrid Imaging, Tom Vettenburg¹, Andy Wood², Nicholas Bustim², Andrew R. Harvey¹; ¹Heriot-Watt Univ., UK, ²Qioptiq Ltd., UK. Optical-digital hybrids are able to increase defocus tolerance; however, choosing the optimal pupil phase modulation is non-trivial. We show how hybrid imaging fidelity can be predicted and compare some of the most common phase-functions.

OTuB • Large Optics

Tuesday, June 15

10:30 a.m.–12:45 p.m.

Joseph Robichaud; L-3 Communication Systems, SSG Tinsley, Inc., USA, Presider

OTuB1 • 10:30 a.m.

Invited

Optical Testing of Mirrors for Giant Telescopes, James Burge; Univ. of Arizona, USA. Today's giant telescopes use mirrors that require new methods of optical testing. This paper summarizes developments at University of Arizona for measuring off-axis primary mirror segments, large convex aspheric secondary mirrors, and giant turning flats.

OTuB2 • 11:00 a.m.

Cryogenic Thermal Mask for Space-Cold Optical Testing for Space Optical Systems, Dae Wook Kim, James H. Burge; College of Optical Sciences, Univ. of Arizona, USA. An optical testing configuration utilizing the Cryogenic Thermal Mask (CTM) provides thermal decoupling between a cryogenic optical system under test and a collimator operating at ambient temperature, while passing the test wavefront without significant degradation.

OTuB3 • 11:15 a.m.

SCOTS: A Quantitative Slope Measuring Method for Optical Shop Use, Peng Su, Robert E. Parks, Lirong Wang, Roger P. Angel, James H. Burge; Univ. of Arizona, USA. SCOTS can rapidly measure highly aspherical shapes such as solar collectors, GMT primary. Implementation of SCOTS needs only a laptop computer. It illuminates surface with LCD screen and use reflected image to determine surface slopes.

OTuB4 • 11:30 a.m.

Edge-Control on Mirror Segments, David Walker¹, Anthony Beaucamp², Guoyu Yu³, Hongyu Li⁴; ¹Univ. College London, Glyndwr Univ., Zeeko Ltd, UK, ²Zeeko Res. Ltd, UK, ³Glyndwr Univ., UK, ⁴Univ. College London, UK. We outline requirements for mirror segment edges for extremely large telescopes, and introduce the new CNC machine for process verification. We review a promising approach for edge-control using the *Precessions* process, and report progress.

**ITuB • Optical Design for Modern Digital Systems and
Computational Imaging—Continued**

ITuB5 • 11:45 a.m.

Invited

Correcting Lateral Chromatic Aberrations by Image Processing, Akihiko Utsugi, Kenichi Ishiga; Core Technology Ctr., Nikon Corp., Japan. We have developed an image processing algorithm that reduces lateral chromatic aberration. It analyzes a captured image to detect aberration without lens information, and reduces aberration by methods optimized for raw images and in-camera-processed images.

OTuB • Large Optics—Continued

OTuB5 • 11:45 a.m.

Student Award Participant

Computation of Misalignment and Primary Mirror Figure Error Parameters of Classical Two-Mirror Telescopes, Tobias Schmid¹, Kevin P. Thompson², Jannick P. Rolland^{3,1}; ¹CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, ²Optical Res. Associates, USA, ³Inst. of Optics, Univ. of Rochester, USA. It is demonstrated how secondary mirror misalignment parameters and primary mirror astigmatic figure error of two-mirror telescopes can be computed utilizing the nodal properties of coma and astigmatism, while taking into account pointing changes.

OTuB6 • 12:00 p.m.

Polishing Large Segments with Hydra, Erika Sohn, Elfego Ruiz, Luis Salas, Esteban Luna, Manuel Núñez, Fernando Quiroz, Francisco Murillo, Joel Herrera, Jorge Valdéz; Inst. de Astronomía, Univ. Nacional Autónoma de México, Mexico. We present improvements to the Hydra polishing system that open the possibility to polish high-precision free-form meter-class optics, and advances on a hollow borosilicate 84-cm mirror and the optical metrology necessary to measure this surface.

OTuB7 • 12:15 p.m.

Invited

Optical Figure Measurement on Convex or Concave, Meter-Class Aspheres with Nanometer-Class Accuracy, Paul Glenn; Bauer Associates, Inc., USA. There is a need for enhanced metrology as the fabrication of large aspheres progresses. We present recent measurement results from our Four Point Stitching Profilometer, providing self-referenced measurement of large aspheres, concave or convex.

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

NOTES

Grand Room International Optical Design Conference (IODC)	Lodge Room, Pavilion International Optical Design Conference (IODC)	Teton Room Optical Fabrications and Testing (OF&T)
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ITuC • Design and Applications of Illumination Systems

Tuesday, June 15
2:00 p.m.–4:00 p.m.
Paul Michaloski; Corning Tropel, USA, *Presider*

ITuC1 • 2:00 p.m. Invited

Evolution of Illumination Systems in Microlithography—A Retrospective, Alois Herkommer; Carl Zeiss SMT AG, Germany. Illumination systems in microlithography have evolved from simple light mixing devices towards ultra-flexible contrast enhancement tools, enabling today's most advanced lithographic processes. A survey of the changing illumination requirements, design concepts and functionality is given.

ITuC2 • 2:30 p.m. Student Award Participant

Design of Illumination Devices for Delivery of Photodynamic Therapy in the Oral Cavity, Cristina Canavesi¹, Florian Fournier^{2,1}, Thomas H. Foster^{1,3}, Jannick P. Rolland^{1,2}; ¹Univ. of Rochester, Inst. of Optics, USA, ²CREOL, College of Optics and Photonics, USA, ³Univ. of Rochester Medical Ctr., USA. We present two designs for delivery of light in the oral cavity for photodynamic therapy under the requirements of average irradiance of 50 mW/cm² and spatial non-uniformities under 10% over an area of 25 mm².

ITuC3 • 2:45 p.m.

Overview of the Gamma Reaction History Diagnostic for the National Ignition Facility (NIF), Robert M. Malone¹, Brian C. Cox¹, Brent C. Frogget¹, Morris I. Kaufman¹, Aric Tibbitts¹, Thomas W. Tunnell¹, Scott C. Evans², Hans W. Herrmann², Yong H. Kim², Joseph M. Mack², Carl S. Young², Kevin D. McGillivray¹, Martin J. Palagi¹, Wolfgang Stoeffl³; ¹Natl. Security Technologies, LLC, USA, ²Los Alamos Natl. Lab, USA, ³Lawrence Livermore Natl. Lab, USA. Off-axis parabolic mirrors relay Cherenkov light from a volume of pressurized gas. This nonimaging optical system has the high-speed detector placed at a stop position with the light delayed until after prompt gammas have passed.

ITuD • Design and Analysis Considerations for Optical System Fabrication and Testing

Tuesday, June 15
2:00 p.m.–4:00 p.m.
David Stephenson; Stillwater Optics, USA, *Presider*

ITuD1 • 2:00 p.m.

Considerations for Selecting a Retrosphere in Interferometric Optical Testing of Objectives, L. Michael Rodgers; Optical Res. Associates, USA. A retrosphere is a convenient element to use in interferometric optical tests, but can cause ambiguities in the interferogram due to Fresnel diffraction. This paper evaluates these effects and presents an alternative retroreflector design concept.

ITuD2 • 2:15 p.m.

Tolerance Analysis of Glass Inhomogeneities, Paolo Spanò; INAF - Natl. Inst. for Astrophysics, Italy. Glass inhomogeneities can be properly taken into account during design and manufacturing phases with ray-tracing routines. Based onto Zernike polynomials, a method is presented to compute tolerances. Results are compared with measurements on glass samples.

ITuD3 • 2:30 p.m.

Meaningful Surface Roughness and Quality Tolerances, David M. Aikens; Savvy Optics Corp., USA. Meaningful surface quality and roughness tolerances can be derived based on physics and requirements rather than history and inertia. This paper describes how to develop such specifications for these annoying parameters.

ITuD4 • 2:45 p.m.

Point Spread Function Artifacts from Structured Mid-Spatial Frequency Errors, John M. Tamkin, Tom Milster; College of Optical Sciences, Univ. of Arizona, USA. Structured mid-spatial frequency surface errors on aspheric optics can create ghost images and reduced contrast. This reduction in performance is shown to be non-linear with surface height using Fourier methods and plane wave spectrum analysis.

OTuC • Laser Writing in Materials

Tuesday, June 15
2:00 p.m.–4:00 p.m.
Brigid Mullany; Univ. of North Carolina at Charlotte, USA, *Presider*

OTuC1 • 2:00 p.m. Invited

Ultrafast Laser Microfabrication of Photonic Devices inside Glass, Kazuyoshi Itoh, Yasuyuki Ozeki; Osaka Univ., Japan. We review the technique of microfabrication inside glass, focusing on the fabrication of photonic devices and the microwelding of glass. We also present temperature analysis of the processed region based on time-resolved Raman spectroscopy.

OTuC2 • 2:30 p.m. Student Award Participant

Laser Polishing of Fused Silica, Annika Richmann¹, Edgar Willenborg², Konrad Wissenbach²; ¹RWTH Aachen Univ., Chair TOS, Germany, ²Fraunhofer Inst. for Laser Technology ILT, Germany. Polishing results of polishing fused silica with CO₂-laser radiation with processing rates up to 1 cm²/s are presented. The roughness of planar surfaces is reduced to Ra<6 nm. Polishing results on spherical lenses are likewise.

OTuC3 • 2:45 p.m. Student Award Participant

Self-Organized Formation of Nanoporous AAO by Prepatterned Nanoimprint Lithography, Sheng-Hui Chen¹, Chun-Ko Chen¹, Bo-Yu Huang¹, Shih-Liang Ku², Chao-Chun Huang²; ¹Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, ²Chung-Shan Inst. of Science and Technology, Taiwan. Periodic nanopores have been fabricated on the aluminum foil using nanoimprint and anodization processes to obtain high order nanostructure. The results show that the growth position of the pores was limited by the pre-patterned design.

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ITuC • Design and Applications of Illumination Systems—Continued

ITuC4 • 3:00 p.m.
Micro-Optics for High-Efficiency Optical Performance and Simplified Tracking for Concentrated Photovoltaics (CPV), William Sweatt, Bradley H. Jared, Greg N. Nielson, Murat Okandan, Anton Filatov, Michael B. Sinclair, Jose L. Cruz-Campa, Anthony L. Lentine; Sandia Natl. Labs, USA. Three-element micro-optical array, enabled by micro-photovoltaic cells, provides simple in-plane fine tracking ($\pm 10^\circ$ FOV) and improves lens and anti-reflection coating optical efficiency. Prototype 49:1 concentration for $400\text{nm} < \lambda < 1600\text{nm}$ demonstrated.

ITuC5 • 3:15 p.m. Student Award Participant
Design, Assembly, and Testing of a Spectral Splitting Solar Concentrator Module, Eric Christensen, Duncan Moore, Greg Schmidt, Blair Unger; Univ. of Rochester, Inst. of Optics, 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.

ITuC6 • 3:30 p.m.
Injecting Light of High-Power LEDs into Thin Light Guides, Hugo J. Cornelissen¹, Chenhung Ho², Haiyan Ma², Marcel P. C. M. Krijn¹, Hans A. van Sprang¹; ¹Philips Res. Europe, Netherlands; ²Delft Univ. of Technology, Optics Res. Group, Netherlands. A new method using a thin-film dielectric multilayer filter is presented to couple light from a $1 \times 1\text{mm}^2$ LED into a 0.3mm thin light guide. Design and optical characterization of thin and compact collimators are discussed.

ITuC7 • 3:45 p.m.
LED Polarization Conversion and Angular Shaping Module for LCD Backlighting, Po-Chun Lin¹, Cheng-Huan Chen¹, Han-Ping Yang², Hung-Yi Lin²; ¹Power Mechanical Engineering Dept., Natl. Tsing Hua Univ., Taiwan; ²Mechanical and System Res. Labs, Industrial Technology Res. Inst., Taiwan. A polarization conversion and angular shaping LED module has been proposed to improve the efficiency and uniformity for direct type LCD backlighting. The design includes simulation based on nanostructure, polarization and geometrical optics.

ITuD • Design and Analysis Considerations for Optical System Fabrication and Testing—Continued

ITuD5 • 3:00 p.m.
Use of the Abbe Sine Condition to Quantify Alignment Aberrations in Optical Imaging Systems, James H. Burge, Chunyu Zhao, Matt B. Dubin; College of Optical Sciences, Univ. of Arizona, USA. Violation of Abbe's sine condition is well known to cause coma in axisymmetric imaging systems. We define non-symmetric violations and show how they come from misaligned optical systems and how they cause image degradations.

ITuD6 • 3:15 p.m.
Controlling Surface Figure Errors of Optical Components, David J. Markason; Raytheon Missile Systems, USA. The random-phase screen transfer function is a useful tool to control the surface figure of optical components. Theory and proposed algorithms, tie in to lens design codes, and example specifications are reviewed.

ITuD7 • 3:30 p.m.
Thermal Considerations in the Design of a Long Focal Length, Low F-Number, Infrared Imager, Harvey M. Spencer; DRS Sensor and Targeting Systems, USA. Long focal length IR optics cause difficulties in achieving performance over varying temperatures due to the large Dn/Dt of IR materials. Modeling results are sensitive to the lens setup. Techniques for design optimization are presented.

ITuD8 • 3:45 p.m.
Tolerance Analysis and Experiment of Injection Double Lens in High Power Solid Laser Facility, Fang Wang, Ping Li, Lanqin Liu, Lei Mo, Donghui Lin, Wengyi Wang, Jingqin Su, Qihua Zhu; Res. Ctr. of Laser Fusion, China Acad. of Engineering Physics, China. The injection lens of the high power solid laser facility built soon was designed as double lens. The tolerance of the double lens was analyzed, and the optical performance of which was detected in experiment.

OTuC • Laser Writing in Materials—Continued

OTuC4 • 3:00 p.m.
Characterization of Photoresist and Study on Developed Resist Profile for the Fabrication of Gray-Scale Diffractive Optic Elements, Jong Rak Park¹, Youngsik Kim², Melissa Zaverton², Justin Sierchio², Tom D. Milster²; ¹Dept. of Photonic Engineering, Chosun Univ., Republic of Korea, ²College of Optical Sciences, The Univ. of Arizona, USA. We have characterized photoresist used for fabrication of gray-scale diffractive optic elements using Dill's and Mack's parameters. Using the fast-marching method, simulations of resist profiles have been shown to match experimental results.

OTuC5 • 3:15 p.m. Student Award Participant
Maskless Lithography Tool for Fabrication and Inspection of Diffractive Optical Elements and Computer Generated Holograms, Melissa A. Zaverton, Justin Sierchio, Young-Sik Kim, Delbert Hansen, Warren Bletcher, John Tamkin, Thomas Milster; Univ. of Arizona, College of Optical Sciences, USA. A high-speed maskless lithography tool is described for fabricating diffractive optical elements and computer generated holograms. The system has the capability to write gray-scale features and is also used for inspection of the sample after fabrication.

OTuC6 • 3:30 p.m. Invited
Novel Optical Materials and Devices by Direct Laser Writing, Georg von Freymann, Stefan Linden, Martin Wegener, Klaus Bade, Volker Saile, Michael Thiel, Michael S. Rill, Manuel Decker, Justyna Gansel; Karlsruhe Inst. of Technology (KIT), Germany. We characterize chiral three-dimensional photonic nanostructures composed of both polymeric and metallic helices. Fabrication involves direct-laser writing and electrochemical deposition of gold. The structures' optical properties reveal new opportunities for realizing advanced polarizing optical devices.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby and Lodge Room, Pavilion

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ITuE • Modeling and Testing of Illuminations Systems and Components

Tuesday, June 15
4:30 p.m.–6:00 p.m.
Richard Pfisterer; Photon Engineering, LLC, USA, President

ITuE1 • 4:30 p.m. Student Award Participant
Modeling Transflective LCD Illumination Systems, *Joshua J. Kim¹, R. John Koshe^{1,2}; College of Optical Sciences, Univ. of Arizona, USA, ²Photon Engineering LLC, USA.* Transflective LCD illumination models are simulated to assess image quality under influence of ambient light in terms of a user viewable image. Currently a contrast improvement of 168% is observed beyond a regular LC display.

ITuE2 • 4:45 p.m. Invited
Fluorescence Modeling in Remote and Close LED Illumination Devices, *Teus Tukker; Philips Lighting, Netherlands.* Light source modeling is an important part of the design of illumination systems. The irradiance and spectral details of the source are important for the design choices and the final performance of the luminair.

ITuE3 • 5:15 p.m. Student Award Participant
A Low-Cost, Flexible, High Dynamic Range Test for Free-Form Illumination Optics, *Lirong Wang¹, Peng Su¹, Robert E. Parks¹, Jose M. Sasian¹, James H. Burge^{1,2}; ¹College of Optical Sciences, Univ. of Arizona, USA, ²Dept. of Astronomy/Steward Observatory, Univ. of Arizona, USA.* Software Configurable Optical Test System (SCOTS), a computerized “reverse Hartmann test,” can rapidly quantitatively measure complex 3-D specular surfaces, for instance solar collectors, faceted automotive headlight or free-form surfaces without complex calibrations.

ITuF • Manufacturing Considerations for Optical Design Producibility and Tolerance Desensitization

Tuesday, June 15
4:30 p.m.–6:00 p.m.
Gary Wiese; Lockheed Martin Corp., USA, President

ITuF1 • 4:30 p.m.
The Adversarial Relationship between Optical Performance and Scratch-Dig, *Cody B. Kreischer; Kreischer Optics, Ltd., USA.* A key cost factor in making an optic is the surface quality (scratch-dig) specification. This paper deals with how an over-emphasis on surface quality can indirectly reduce the “as built” performance of optical systems.

ITuF2 • 4:45 p.m.
Lens Solutions Which Increase Manufacturing Yield, *Stan Szapiel, Catherine Greenhalgh; ELCAN Optical Technologies, Canada.* The classic method of design centering commonly used to increase the yield of electronic circuits is employed to improve manufacturability of complex lens designs.

ITuF3 • 5:00 p.m. Student Award Participant
The Effect of Selective Assembly on Tolerance Desensitization, *Max C. Funck¹, Peter Loosen^{1,2}; ¹RWTH Aachen Univ., Germany, ²Fraunhofer Inst. for Laser Technology, Germany.* Cost reduction and increased as-built performance can be achieved through both tolerance desensitization and use of compensators. We investigate how desensitization of selected parameters can further relax tolerances while using selective assembly as a compensator.

ITuF4 • 5:15 p.m.
Withdrawn

OTuD • Freeform Optics

Tuesday, June 15
4:30 p.m.–6:00 p.m.
Jannick P. Rolland; Inst. of Optics, Univ. of Rochester, USA, President

OTuD1 • 4:30 p.m. Invited
Comparison of Linear Z-Axis and Rotational B-Axis Freeform Diamond Turning, *Gregg E. Davis¹, Jeffrey W. Roblee², Steven M. Omecinski¹, Alan Hedges¹; ¹II-VI Inc., USA, ²Ametek Precitech, USA.* In a cutting comparison between X-C-Z and X-C-B Slow Tool Servo techniques, the rotational B-axis achieved comparable figure results to the linear Z-axis, but finish suffered due to sub-divisional errors of the B-axis encoder.

OTuD2 • 5:00 p.m. Student Award Participant
The Assessment of a Stable Radial Basis Function Method to Describe Optical Free-Form Surfaces, *Ilhan Kaya¹, Ozan Cakmakci², Kevin Thompson², Jannick P. Rolland³; ¹CREOL, College of Optics & Photonics, Univ. of Central Florida, USA, ²Optical Res. Associates, USA, ³Inst. of Optics, Univ. of Rochester, USA.* This paper assesses a stable Radial Basis Function method to describe optical free-form surfaces. The main contribution is determination of number of basis required to achieve an accuracy demanded by non-imaging, precision, and lithography optics.

OTuD3 • 5:15 p.m.
Multi-Point Low-Coherence Optical Probe for Freeform Optical Metrology, *Damon W. Diehl, Christopher T. Cotton, Christopher J. Ditchman, Nathan E. Burdick, Howard S. Ammenheuser; ASE Optics, USA.* We have developed a four-beam non-contact optical probe that uses low-coherence interferometry to measure the position and orientation of the interior and exterior surfaces of a freeform optic by scanning the probe over the object.

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ITuE • Modeling and Testing of Illuminations Systems and Components—Continued

ITuE4 • 5:30 p.m.
Backward Modelling of LED Primary Optics, Andre Domhardt, *Simon Wendel, Cornelius Neumann; Karlsruhe Inst. of Technology, Germany.*
 Secondary optic tailoring requires an appropriate, point source based, primary optic model, which can be calculated from spatial radiation patterns by applying backward tailoring. Furthermore, we demonstrate the resulting improvements on the design process.

ITuE5 • 5:45 p.m.
Withdrawn

ITuF • Manufacturing Considerations for Optical Design Producibility and Tolerance Desensitization—Continued

ITuF5 • 5:30 p.m.
Tolerance Assignment for Minimizing Manufacturing Cost, Michael Kehoe; *Resonon Inc., USA.* An automated procedure for tolerance assignment is described. Tolerances are assigned so as to minimize manufacturing cost, subject to a constraint on minimum acceptable lens performance. A simulation evaluates the cost-effectiveness of the program.

ITuF6 • 5:45 p.m.
Manufacturable Mobile Phone Optics: Higher Order Aspheres Are Not Always Better, James P. McGuire; *Optical Res. Associates, USA.* We review the design drivers for mobile camera phones, with particularly the aspheric order. The designer is often tempted to use high order aspheres, but better as-built performance can often be obtained at lower orders.

OTuD • Freeform Optics—Continued

OTuD4 • 5:30 p.m. **Invited**
Precise Fast Molding of Optical Freeforms, Jan Hamkens; *Docter Optics GmbH, Germany.*
 Explanation and market needs for high-efficiency molding of optical freeforms for illumination, solar, analytics and other industries - optical design, tool shop, high resolution measures, integrated tool optimization ◊ from prototyping to large scale production.

6:00 p.m.–7:30 p.m. Joint Conference Reception, Atrium

7:00 p.m.–8:00 p.m. Memorial Program, Grand Room

NOTES

Wednesday, June 16, 7:30 a.m.–5:30 p.m. Registration Open, Lobby

IWA • Polarization in Optical Design

Wednesday, June 16

8:00 a.m.–9:45 a.m.

Costin E. Curatu; Alcon Labs, USA, Presider

IWA1 • 8:00 a.m.

Student Award Participant

Ray Tracing in Biaxial Materials, *Wai Sze Tiffany Lam, Stephen McClain, Gregory Smith, Russell Chipman; College of Optical Sciences, Univ. of Arizona, USA.* Algorithms for polarization ray tracing biaxial materials and calculating the directions of ray propagation and energy flow, the refractive indices, and the coupling coefficients for all four resultant reflected and transmitted rays are presented.

IWA2 • 8:15 a.m.

Student Award Participant

Low Polarization Microscope Objectives, *Brian J. Daugherty, Russell Chipman; Univ. of Arizona, USA.* Microscope objectives used for biaxial ellipsometry require small levels of polarization aberrations. The approach outlined in this paper allows the design and fabrication of microscope objectives with twelve times less diattenuation than commercially available objectives.

IWA3 • 8:30 a.m.

Using Orientation Zernike Polynomials to Predict the Imaging Performance of Optical Systems with Birefringent and Partly Polarizing Components, *Johannes Ruoff, Michael Totzeck²; ¹Carl Zeiss SMT AG, Germany, ²Carl Zeiss AG, Germany.* We use the concept of Orientation Zernike Polynomials, which have been shown to provide a complete and systematic description of vector imaging, to predict the polarization performance of high NA lithography lenses.

IWA4 • 8:45 a.m.

Invited

Challenges for Polarization Ray Tracing, *Russell A. Chipman; College of Optical Sciences, Univ. of Arizona, USA.* New polarization methods allow the ray tracing simulation of polarization critical components, including multilayer biaxial films, anisotropic and gyrotropic crystals, electro-optical, magneto-optical, and stressoptical modulators, photonic crystals and meta-materials.

OWA • Materials Processing and Damage

Wednesday, June 16

8:00 a.m.–10:00 a.m.

Jessica DeGroot Nelson; Optimax Systems Inc., USA, Presider

OWA1 • 8:00 a.m.

Invited

Optical Fabrication and Post Processing Techniques for Improving Laser Damage Resistance of Fused Silica Optics, *Tayyab Suratwala; Lawrence Livermore Natl. Lab, USA.* With improved optical fabrication and new post-treatments, the laser resistance of fused silica optical surfaces has increased dramatically in the past 12 years, enabling practical optic lifetimes during high laser fluence operation.

OWA2 • 8:30 a.m.

A Simple Method to Improve Etching Uniformity when Making Phase Type CGHs on a Thick Glass Substrate, *Quandou Wang¹, Lei Chen², Ulf Griesmann¹; ¹Manufacturing Engineering Lab, NIST, USA, ²Center for Nanoscale Science and Technology, NIST, USA.* A simple method to optimize the etching uniformity when making a CGH on a thick optical glass substrate is described, which uses a Teflon ring to enclose the substrate during reactive-ion etching (RIE).

OWA3 • 8:45 a.m.

Evaluating Subsurface Damage with Quantum Dots, *Wesley Williams, Brigid Mullany, Wesley Parker, Patrick Moyer; Univ. of North Carolina at Charlotte, USA.* Quantum dots were added to abrasive slurries used to finish glass samples. Confocal fluorescence microscopy detected quantum dots up to 7 μm beneath the surface, agreeing with depths of brittle fracture observed by etching.

OWA4 • 9:00 a.m.

A New Method of Damage Determination: 3-D Metrology, *Jean-Philippe Champreux¹, Olivier Cahuc¹, Philippe Darnis², Jean-Yves K'nevez¹, Reynald Laheurte², Nathalie Darbois³, Jérôme Néauport³; ¹Lab de Mécanique Physique, Univ. de Bordeaux, France, ²Lab de Génie Mécanique et Matériaux de Bordeaux, Univ. de Bordeaux, France, ³CEA CESTA, France.* This paper presents a new approach to measure damage created by the grinding operation. It presents the Abbott-Firestone curve and the depth distribution used to take information on the damage created under the surface.

IWA • Polarization in Optical Design—Continued

IWA5 • 9:15 a.m.

Student Award Participant

Imprinting Aberrations in the Stokes Parameters of a Focal Spot, *Amber M. Beckley*, *Thomas G. Brown*; *Inst. of Optics, Univ. of Rochester, USA*. We explore polarization distribution in point spread functions and Stokes parameter signatures of pupil aberrations. With the aid of stress-engineered optical elements, we explore how pupil aberrations map onto Stokes parameters in the focal plane.

IWA6 • 9:30 a.m.

Student Award Participant

Three-Dimensional Polarization Ray Tracing, Retardance, *Garam Yun*, *Russell Chipman*; *College of Optical Sciences, Univ. of Arizona, USA*. The retardance associated with a three-by-three polarization ray tracing matrix **P** is analyzed. A method to separate the geometrical transformation from the “physical” retardance is presented using a non-polarizing ray tracing matrix **Q**.

OWA • Materials Processing and Damage—Continued

OWA5 • 9:15 a.m.

Initiation of Laser Damage at Surface Imperfections on Fused Silica Optics, *Philip E. Miller*, *Tayyab I. Suratwala*, *Jeffrey D. Bude*, *Joseph A. Menapace*, *Nan Shen*, *Ted A. Laurence*, *William A. Steele*, *Michael D. Feit*, *Lana L. Wong*; *Lawrence Livermore Natl. Lab, USA*. Imperfections on optical surfaces contain fractured, densified and displaced material. After physical isolation, the laser damage susceptibility of specific defect structures has been determined. Fractures, rather than displaced or densified material limits laser damage performance.

OWA6 • 9:30 a.m.

Invited

Development of Transparent Ceramic Spinel (MgAl₂O₄) for Armor Applications, *Anthony Sutorik*; *US ARL, USA*. This paper will describe the Army’s efforts to develop polycrystalline transparent ceramic from magnesium aluminate spinel (MgAl₂O₄) for transparent armor applications, with particular emphasis on the development of cost effective ceramic powder synthesis and processing.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby

10:00 a.m.–4:30 p.m. Exhibits Open, Mezzanine-Grand/Lobby

NOTES

IWB • Nonimaging Optical Design Techniques

Wednesday, June 16
10:30 a.m.–12:30 p.m.
G. Groot Gregory; Optical Res. Associates, USA, Presider

IWB1 • 10:30 a.m.
SWEPT CONICS: Single Mirror Transformers, Paul K. Manhart
NASA Langley Res. Ctr., USA. A class of optical surfaces called "Swept Conics" can be used to transform wavefronts from point sources to diffraction limited line or arc images, and vice versa.

IWB2 • 10:45 a.m. Invited

Edge-Ray and Aplanatic Designs as Special Cases of Generalized Functional Designs, John C. Bortz, *Narkis Shatz; SAIC, USA.* We show that both edge-ray and aplanatic concentrators are special cases of generalized functional designs. The formulas associated with the generalized functional method provide a convenient means of generating the shape profiles of such concentrators.

IWB3 • 11:15 a.m.
Novel Ideal Nonimaging Designs by Multichanneling the Phase-Space Flow, Juan C. Miñano^{1,2}, Pablo Benitez^{1,2}, Julio Chaves², Jiayao Liu¹, Jose Infante¹; ¹*Univ. Politécnica de Madrid, Spain*, ²*LPI, USA.* New ultra-thin SMS optical designs are presented. They are formed by discontinuous sections working in parallel (multichannel) to provide the desired optical function. Aplanatic (a particular case of SMS-design) multichannel very-thin designs are also shown.

IWB4 • 11:30 a.m. Student Award Participant

Freeform Reflector Design Using Integrable Maps, Florian R. Fournier¹, *William J. Cassarly*², *Jannick P. Rolland*^{1,3}; ¹*CREOL, Univ. of Central Florida, USA*, ²*Optical Res. Associates, USA*, ³*Univ. of Rochester, USA.* We propose a design method for freeform reflectors based on source-target maps. The necessity to fulfill the integrability condition to obtain a smooth reflector surface is discussed and demonstrated with various reflector geometries.

OWB • Materials Processing and Damage—Continued

Wednesday, June 16
10:30 a.m.–11:15 a.m.
Jessica DeGroot Nelson; Optimax Systems Inc., USA, Presider

OWB1 • 10:30 a.m.
Laser Controlled Fracture Strength in Chemically Strengthened Glass, Kyle Hoff, *Xinghua Li, G. Scott Glaesemann; Corning Inc., USA.* Surface heating lasers with a quenching process can create controlled scribe lines with high edge strength. This work compares the edge strength of different chemically strengthened glasses with laser scribe and break edges.

OWB2 • 10:45 a.m. Invited

Corrosion Resistant Zirconia Coated Carbonyl Iron Particle-Based Magnetorheological Fluid, Shai Shafrir^{1,2}, *Henry J. Romanofsky*³, *Michael Skarlinski*², *Mimi Wang*⁴, *Chunlin Miao*⁵, *Sivan Salzman*⁵, *Taylor Chartier*⁴, *Joni Mici*², *John C. Lambropoulos*², *Rui Shen*⁴, *Hong Yang*⁴, *Stephen D. Jacobs*³; ¹*OptiPro Systems, Inc., USA*, ²*Dept. of Mechanical Engineering, Univ. of Rochester, USA*, ³*Lab for Laser Energetics, Univ. of Rochester, USA*, ⁴*Dept. of Chemical Engineering, Univ. of Rochester, USA*, ⁵*Materials Science Program, Dept. of Mechanical Engineering, Univ. of Rochester, USA.* Zirconia coated carbonyl iron particle-based magnetorheological fluid was developed for magnetorheological finishing. Particles were coated via sol-gel synthesis. Spot polishing tests were performed over 3 weeks with no signs of fluid degradation or corrosion.

OWC • Micro-Integrated Optics

Wednesday, June 16
11:15 a.m.–12:30 p.m.
Matt Dubin; College of Optical Sciences, Univ. of Arizona, USA, Presider

OWC1 • 11:15 a.m. Invited

Glass Micro-Optics for Laser Beam Shaper and LED Collimation, Steffen Reichel, *Ralf Biertümpfel, Volker Wittmer; SCHOTT AG, Germany.* A design and measurements of glass diffractive optical beam shaper is shown generating a 'flat hat' light distribution. Furthermore the design of a LED collimation lens is presented including the manufacturing as lens array.

IWB • Nonimaging Optical Design Techniques—Continued

OWC • Micro-Integrated Optics—Continued

IWB5 • 11:45 a.m.

Invited

Optical Design of Inhomogeneous Media to Perfectly Focus Scalar Wave Fields, Pablo Benitez, Juan C. Miñano, Juan C. González; Univ. Politécnica de Madrid, Spain. A method to design isotropic inhomogeneous refractive index distribution is presented, in which the scalar wave field solutions propagate exactly on eikonal functions, allowing perfect focusing from a point source onto a point absorber.

IWB6 • 12:15 p.m.

Student Award Participant

Nobel Fast Catadioptric Objective with Wide Field of View, Jose M. Infante Herrero^{1,2}, Fernando Muñoz³, Pablo Benitez², Juan Carlos Miñano², Wang Lin¹, Juan Vilaplana³, Guillermo Biot¹, Marta de la Fuente⁴; ¹Univ. Politécnica de Madrid, CEDINT, Spain, ²Indra Sistemas SA, Spain, ³LPI, USA, ⁴INDRA SISTEMAS SA, Spain. Using the Simultaneous Multiple Surface method in 2D (SMS2D), we present a fast catadioptric objective with a wide field of view (125°x96°) designed for a microbolometer detector with 640x480 pixels and 25 microns pixel pitch.

OWC2 • 11:45 a.m.

Single Arm Interferometer System for Reflective Micro-Device Phase Measurement, Dale E. Ewbank; Rochester Inst. of Technology, USA. A Pohl fringe-producing system is used to measure phase for reflective electro-optical micro-devices at visible wavelengths. Relative phase versus voltage is extracted for devices utilizing polymer dispersed liquid crystal materials as the active layer.

OWC3 • 12:00 p.m.

Cost Optimized Fabrication of Micro-Optical Couplers, José Fernando Merchán Alba¹, Karl-Heinz Brenner¹, Rainer Börret², Uwe Berger²; ¹Univ. Heidelberg, Germany, ²Hochschule Aalen, Germany. A cost effective fabrication method is applied to manufacture micro-optics. It allows the integration of micro-optical components. We used this technique to fabricate negative metal-masters of optical micro-couplers and replicated them in a monolithic substrate.

OWC4 • 12:15 p.m.

The Use of Elastic Averaging for Fabrication of Micro-Optics in a High Efficiency Photovoltaic System, Bradley Jared, David Gill, William Sweatt, Gregory Nielson, Murat Okandan, Anton Filatov; Sandia Natl. Labs, USA. Elastic averaging is introduced as a methodology for the fabrication and assembly of multi-element, micro-optic arrays. Its performance and use is evaluated in the demonstration of a high efficiency, photovoltaic tracking system.

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

NOTES

IWC • Beam Shaping and Propagation

Wednesday, June 16
2:00 p.m.–4:00 p.m.
Daniel G. Smith; Nikon Res. Corp. of America, USA, Presider

IWC1 • 2:00 p.m. Invited

Unified Optical Modeling, Frank Wyrowski¹, Michael Kuhn²; ¹Friedrich Schiller Univ. Jena, Germany, ²LightTrans GmbH, Germany. Unified optical modeling aspires to place all significant modeling techniques into the same framework in order to enable a smooth combination of them in a modeling task. We call this theoretical modeling concept field tracing.

IWC2 • 2:30 p.m.

Gouy Phase Anomaly in Astigmatic Beams, Jannick P. Rolland^{1,2}, Tobias Schmid², John Tamkin Jr.¹, Kye-Sung Lee¹, Kevin P. Thompson³, Emil Wolf¹; ¹Univ. of Rochester, USA, ²CREOL, Univ. of Central Florida, USA, ³Optical Res. Associates, USA. We simulate the newly predicted Gouy phase anomaly near astigmatic foci of Gaussian beams using a beam propagation algorithm integrated with lens design software and compare computational results with experimental data.

IWC3 • 2:45 p.m. Invited

Mathematical Aspects of Laser Beam Shaping and Splitting, Louis A. Romero¹, Fred M. Dickey²; ¹Sandia Natl. Labs, USA, ²FMD Consulting, USA. We will discuss general mathematical ideas arising in the problems of Laser beam shaping and splitting. We will be particularly concerned with questions concerning the scaling and symmetry of such systems.

IWC4 • 3:15 p.m.

Student Award Participant

Airy Beams: Beyond Geometric Optics, Sophie Vo¹, Kyle Fuerschbach¹, Charlotte Pachot¹, Tobias Schmid², Kevin P. Thompson³, Jannick P. Rolland¹; ¹Inst. of Optics, Univ. of Rochester, USA, ²CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, ³Optical Res. Associates, USA. Airy beams are a new class of nondiffracting beam predicted in 1979 and observed in 2007. Beam propagation methods are shown to be an effective way to study the behavior of the beams in propagation.

OWD • Grinding/Cutting/Molding

Wednesday, June 16
2:00 p.m.–4:00 p.m.
Aric B. Shorey; Corning, Inc., USA, Presider

OWD1 • 2:00 p.m. Invited

Unique and Unusual Applications of Ultraprecision ELID Grinding and Diamond Cutting, Hitoshi Ohmori; RIKEN, Japan. Electrolytic in-process dressing (ELID) applications continue to expand. This talk describes the fabrication of large, double sided spherical Fresnel lenses for space telescope and solar light concentration optics by direct machining and replication molding.

OWD2 • 2:30 p.m.

Investigations on Grinding Tools for Silicon Carbide Based Advanced Materials, Christian Vogt, Markus Schinhaerl, Florian Schneider, Peter Sperber, Rolf Rascher; Univ. of Applied Sciences Deggendorf, Germany. The results of experiments with grinding tools for carbon fibre infiltrated Silicon Carbide (C/C-SiC) materials are presented. Trials with ELID-support show improved selfsharpening. Resin bond tools improved the surfaces smoothness whereas the form deviation increased.

OWD3 • 2:45 p.m.

Investigations on Magnetorheological Finishing of High-Quality Optical Surfaces with Varying Influence Function, Markus Schinhaerl, Christian Vogt, Florian Schneider, Peter Sperber, Rolf Rascher; Univ. of Applied Sciences Deggendorf, Germany. The paper reports on a testing series with a varying influence function (Spot) in magnetorheological finishing. Effects on the polishing quality and recent developments in the field of varying influence functions are presented and discussed.

OWD4 • 3:00 p.m.

Optimization of Deterministic Microgrinding (DMG) Conditions for Optical Glasses and Ceramics, Shai N. Shafrir^{1,2}, Christopher D. Roll², Paul D. Funkenbusch²; ¹OptiPro Systems, USA, ²Dept. of Mechanical Engineering, Univ. of Rochester, USA. Surface roughness under deterministic microgrinding conditions (fixed in-feed rate) with bond abrasive diamond ring tools is correlated to process conditions. Five different commercial sets of rough and medium tools were tested.

OWD5 • 3:15 p.m.

Optical Characterization of Molded Glass Optics, Allen Y. Yi¹, Fritz Klocke², Olaf Dambon², Fei Wang², Yang Chen¹, Wei Zhao¹; ¹Ohio State Univ., USA, ²Fraunhofer Inst. for Production Technology, Germany. This paper delineates a detailed study of refractive index and its variation in compression molding of precision glass optical lenses.

IWC • Beam Shaping and Propagation—Continued

OWD • Grinding/Cutting/Molding—Continued

IWC5 • 3:30 p.m.

Invited

Microstructured Optics for Excimer-Based Systems: Applications for Imaging, Beam Shaping and Coherence Management, Robert Brunner^{1,2}, Hans Jürgen Dobschal³, Reinhard Steiner², Matthias Burkhardt², Matthias Cumme², Oliver Sandfuchs², Dennis Lehr², Michael Helgert²; ¹Univ. of Applied Sciences Jena, Germany, ²Carl Zeiss Jena GmbH, Technology Div., Germany, ³Carl Zeiss AG, Central Res., Germany. Imaging DOEs, randomly distributed microlenses and sub- λ -structures allow the improvement of the performance of Excimer-based imaging and illumination systems. The potentials and the challenges are discussed especially with the focus on the local profile.

OWD6 • 3:30 p.m.

Invited

Advanced Molded Glass Lenses, Jayson Nelson, Edward Patton; Rochester Precision Optics, USA. In this presentation I will discuss recent development efforts to mold diffractive surfaces, lens arrays, and IR materials, and demonstrate how aspheres are being used in the design phase to improve overall system performance.

4:00 p.m.–4:30 p.m. Coffee Break/Exhibits, Mezzanine-Grand/Lobby

NOTES

IWD • Optical Systems II: Zoom Lenses and Advanced Optical System Design

Wednesday, June 16

4:30 p.m.–6:15 p.m.

Michael Gauwin; Lambda Res. Corp., USA, Presider

IWD1 • 4:30 p.m.

Optical Design Challenges of NFIRAOS, the First-Light Adaptive Optics System for TMT, Jenny Atwood, Peter Byrnes, Glen Herriot; Natl. Res. Council Canada, Herzberg Inst. of Astrophysics, Canada. NFIRAOS is a diffraction-limited, near-IR, multi-conjugate adaptive optics system. We present an overview of the optical design and design drivers, with particular attention given to the challenges of the laser guide star wavefront sensing optics.

IWD2 • 4:45 p.m.

Design and Construction of a Short-Wave Infrared 3.3X Continuous Zoom Lens, Craig Olson, Tim Goodman, Chris Addiego, Steve Mifsud; L3 Communications, Sonoma Electro-Optics, USA. We outline a design process for short-wave infrared (SWIR) continuous zoom lenses using a given design form that addresses the reduced material dispersion and corresponding aberration shifts in that band. Measurement data confirms the approach.

IWD3 • 5:00 p.m.

Toward the Global Optimum in Lithographic Lens Design, Aurelian Dodoc; Carl Zeiss AG, Germany. Significant advances have been made in recent years in the development of the lithography optics. This article describes the best performing lens types and design principles of the catadioptric concept of these lenses.

IWD4 • 5:15 p.m.

Performance of a Liquid Lens Enabled Optical Coherence Microscope with Gabor Fusion, Jannick P. Rolland^{1,2}, Supraja Murali^{2,3}, Panomsak Meemon², Paul Glenn⁴, Kevin P. Thompson⁵, Kye-Sung Lee¹; ¹Inst. of Optics, Univ. of Rochester, USA, ²CREOL, Univ. of Central Florida, USA, ³General Optics Asia, Ltd., India, ⁴Bauer Associates, Inc., USA, ⁵Optical Res. Associates, USA. A custom microscope with an integrated Varioptic liquid lens has been fabricated and shown to provide subcellular resolution using Gabor image fusion. MTF testing and final fused images are shown.

IWD5 • 5:30 p.m.

Third Order Dispersion Effects Generated by Achromatic Doublets on sub-20 Femtosecond Optical Pulses, Martha Rosete-Aguilar, Flor C. Estrada-Silva, Jesus Garduño-Mejía, Neil C. Bruce; Ctr. de Ciencias Aplicadas y Desarrollo Tecnológico, Univ. Nacional Autónoma de México, México. We analyze the focusing of 20fs and 15fs ultrashort pulses using achromatic lenses by expanding the wave numbers of the pulse around the center frequency of the incident pulse up to the third order.

OWE • Mid-Spatials and PSD

Wednesday, June 16

4:30 p.m.–6:00 p.m.

David Aikens; Savvy Optics Corp., USA, Presider

OWE1 • 4:30 p.m.

Invited

Power Spectral Density: Is It Right?, John P. Lehan^{1,2}, Ulf Griesmann³, Jiyoung Chu^{3,4}; ¹NASA Goddard Space Flight Ctr., USA, ²Dept. of Physics, Univ. of Maryland, Baltimore County, USA, ³Natl. Inst. of Standards and Technology, USA, ⁴Samsung Electronics Co., Korea, Republic of. We concentrate on the instrumental issues surrounding power spectral density (PSD) determination employing Fizeau interferometers. We briefly discuss the properties of an ideal calibration method and some methods that have been used previously.

OWE2 • 5:00 p.m.

VIBE™ Finishing to Remove Mid-Spatial Frequency Ripple, Jessica DeGroote Nelson, Brandon Light, Daniel Savage, Robert Wiederhold, Michael Mandina; Optimax Systems Inc., USA. The VIBE process is a full-aperture, conformal polishing process incorporating high frequency and random motion designed to rapidly remove sub-surface damage in a VIBE pre-polish step and eliminate MSF errors in a VIBE finishing step.

OWE3 • 5:15 p.m.

Optical Surface Specification Using the Structure Function, Robert E. Parks; College of Optical Sciences, Univ. of Arizona, USA. The structure function is suggested as a means of specifying surface figure and roughness in order to avoid surface errors that have regions of high slope that produce unacceptable imaging performance.

OWE4 • 5:30 p.m.

Detection and Removal of Spatial Mid-Frequencies in Sub-Aperture Finishing, Oliver Fährle, Safer Mourad, Karin Hauser, Mark Meeder; FSIBA OPTIK AG, Switzerland. A study is presented on the generation and removal of mid-frequencies in sub-aperture polishing applying Fluid Jet Polishing. To that aim, the footprint diameters are scaled and optimized by analyzing their impact on PSDs.

IWD • Optical Systems II: Zoom Lenses and Advanced Optical System Design – Continued

IWD6 • 5:45 p.m.

Dual Band Infrared Continuous Zoom Lenses, *Jay N. Vizgaitis*; US Army RDECOM CERDEC NVESD, USA. Three design solutions for dual band continuous zoom lenses for dual band MWIR/LWIR detectors. The designs maximize zoom range and performance while minimizing lens count. Dual f/number capability is utilized to increase the zoom range.

IWD7 • 6:00 p.m.

Student Award Participant

Active Imaging Lens with Real-Time Variable Resolution and Constant Field of View, *Jocelyn Parent*; Simon Thibault; Laval Univ., Pavilion of Optics and Photonics, Canada. We present a smart lens with an active optic element to modify in real-time the distortion. This way, while keeping the total field of view constant, the resolution is increased in a zone of interest.

IWE • Design and Illumination Problem Presentations and Student Awards Ceremony

Wednesday, June 16
7:30 p.m.–9:30 p.m.

Join the IODC community for a guaranteed highlight of the conference: the illumination and lens design contest presentations. As usual, significant work has gone into developing and scoring the submissions, as well as all of the hard work put in by solution submitters. Additionally, the winners of the best student paper awards for the 2010 IODC will be announced at the conclusion of the design problem presentations.

See the “Conference Highlights” section in the front of the book for more information on the design problems and student presentation awards.

OWE • Mid-Spatials and PSD—Continued

OWE5 • 5:45 p.m.

2-D Spatial Frequency Considerations in Comparing 1D Power Spectral Density Measurements, *Peter Z. Takacs*¹, Sam Barber², Eugene L. Church¹, Konstantine Kaznatcheev¹, Wayne R. McKinney², Valeriy Yashchuk²; ¹Brookhaven Natl. Lab, USA, ²Lawrence Berkeley Natl. Lab, USA. The frequency footprint of 1D and 2D profiling instruments needs to be carefully considered in comparing 1D surface roughness spectrum measurements made by different instruments. Contributions from orthogonal direction frequency components can not be neglected.

OWE • Student Awards Ceremony and H. John Wood Presentation

Wednesday, June 16

6:00 p.m.–7:15 p.m.

Jessica DeGroot Nelson; Optimax Systems Inc., USA, *President*
Stephen Jacobs; Univ. of Rochester, USA, *President*

6:00 p.m.

OF&T Student Award Presentations

Through the generous support of the OSA Foundation, the OF&T Best Student Paper Award has been established to encourage excellence in research and scientific presentation skills in the student optics community. Awards include a cash prize and a certificate. There will be first- and second-place winners for both oral and poster presentations.

OWF1 • 6:30 p.m.

Invited

Hubble Anthology, *H. John Wood*; NASA Goddard Space Flight Ctr., USA. Orbiting high above the turbulence of the earth’s atmosphere, the Hubble Space Telescope (HST) is providing breathtaking views of astronomical objects never before seen in such detail. Understanding the images makes them even more beautiful.

See the “Conference Highlights” section in the front of the book for more information on H. John Wood, including a photo and a bio.

Thursday, June 17, 7:30 a.m.–10:00 a.m. Registration Open, Lobby

IThA • Design of Illumination Systems: Optimization and Tolerancing Approaches

Thursday, June 17
8:00 a.m.–10:00 a.m.
Narkis Shatz; SAIC, USA, *Presider*

IThA1 • 8:00 a.m.

Optimization of Illumination Systems Using Moment of Illumination Data, *Kenneth E. Moore*, [Mark G. Nicholson](#); ZEMAX Development Corp., USA. Moment of Illumination data is shown to be a useful optimization target in illumination systems, yielding smooth merit functions and good noise tolerance.

IThA2 • 8:15 a.m.

Invited

Iterative Reflector Design Using a Cumulative Flux Compensation Approach, [William Cassarly](#); Optical Res. Associates, USA. Some illumination design approaches use the (actual illuminance)/(desired illuminance); however, the ratio is undefined when the actual and desired illuminance distributions have different sizes. We show an encircled energy approach that avoids this limitation.

IThA3 • 8:45 a.m.

Monte Carlo Tolerancing Tool Using Non-Sequential Ray Tracing on a Compute Cluster, [Christopher Reimer](#); Elcan Optical Technologies, Canada. Monte Carlo tolerancing and non-sequential ray tracing are both known to have a high computational cost. This paper describes an almost interactive tool that combines these techniques on a compute cluster.

IThA4 • 9:00 a.m.

Invited

Perturbative Design of Illumination Systems, [R. John Koshe](#)^{1,2}; ¹Photon Engineering LLC, USA, ²College of Optical Sciences, Univ. of Arizona, USA. Using the principles behind perturbation theory allows designs based on realistic inputs to be iteratively designed, optimized and/or tolerated. A reflective system will be used to illustrate the technique.

OThA • Aspheres

Thursday, June 17
8:30 a.m.–10:00 a.m.
Jeffrey L. Ruckman; Lockheed Martin Missiles and Fire Control, USA, *Presider*

OThA1 • 8:30 a.m.

Superpolishing Aspherical Mirrors Using Active Optics, [Emmanuel Hugot](#)¹, *Marc Ferrari*¹, *Kacem El Hadi*¹, *Gerard Lemaitre*¹, *Pierre Montiel*¹, *Kjetil Dohlen*¹, *Pascal Puget*², *Jean Luc Beuzit*²; ¹Lab d'Astrophysique de Marseille, France, ²Lab d'Astrophysique de Grenoble, France. Progress in active optics allowed superpolishing under stress of three toric mirrors for the VLT-SPHERE instrument, minimizing residual speckles in stellar images and improving the accuracy of exoplanet detection.

OThA2 • 8:45 a.m.

Optical Testing Techniques for Highly Aspheric Tertiary Mirrors, [Steven P. Maffett](#), *Steven D. O'Donohue*; ITT Geospatial Systems, USA. ITT Geospatial Systems has completed a Highly Aspheric Tertiary (HAT) strip mirror. The off axis conic was successfully processed and this paper documents that separate refractive and holographic null tests are both acceptable methods.

OThA3 • 9:00 a.m.

Nulling Fizeau Interferometer for Aspheric Surface Measurements, *Piotr Szwaykowski*, [Artur Olszak](#); Engineering Synthesis Design, Inc., USA. Sub-Nyquist interferometry offers a way to bypass fringe density limitations but has several restrictions. In this paper we discuss a new method of measurements which simplifies alignment and alleviates most phase unwrapping and retrace errors.

IThA • Design of Illumination Systems: Optimization and Tolerancing Approaches—Continued

OThA • Aspheres—Continued

IThA5 • 9:30 a.m.

Illumination Design and Optimization Strategies, Henning Rehn: OSRAM Specialty Lighting, Germany. We report our experiences on the optimization of illumination systems and discuss how to take advantage of multi CPU computers. As an example, the design of a LED airfield lamp is shown.

IThA6 • 9:45 a.m.

Fresnel Based Phase Optimised General Error Diffusion Algorithm for Optical Beam Shaping, Jamie L. Ramsey^{1,3}, Victor P. Sivokon¹, Trevor J. Hall², Ivan Andonovic³, Craig Michie³: ¹ELCAN Optical Technologies, Canada, ²Univ. of Ottawa, Photonic Technology Lab, Canada, ³Univ. of Strathclyde, Dept. of Electronic and Electrical Engineering, UK. A method for performing optical beam shaping in the near-field region using diffractive optical elements generated by Fresnel based phased optimised general error diffusion algorithm.

OThA4 • 9:15 a.m.

Combined CGH with Aperture Divided into Angular Sectors for Null Corrector Certification, Ruslan K. Nasyrov, Alexander G. Poleshchuk; Inst. of Automation and Electrometry, Russian Acad. of Science SB RAS, Russian Federation. Encoding method of spherical and aspherical wavefronts into one computer-generated hologram is presented. Diffractive structures are alternately inscribed into angular sector sub-apertures. Aspherical wavefront errors are identified by those of the spherical wavefront.

OThA5 • 9:30 a.m.

Invited

Fabrication of Aspheric Deposits by CW Laser Deposition, Luis Rubio-Peña, José Andrés Ángel, Juan Valverde, Juan María González-Leal; Univ. of Cadiz, Spain. A novel method for the fabrication of aspherics by a continuous-wave laser deposition technique is introduced and results for an IR-transmitting amorphous As-S alloy are reported.

10:00 a.m.–10:30 a.m. Coffee Break, Mezzanine-Grand/Lobby

NOTES

IThB • What's in Your Optical Design and Analysis Toolkit?

Thursday, June 17
10:30 a.m.–12:30 p.m.
Mark G. Nicholson; ZEMAX Development Corp., USA, Presider

IThB1 • 10:30 a.m.

Global Optimization with Traveling Aspherics—Aspheric Surface Number as Continuous Variable, *Akira Yabe*, Consultant, Germany. The author proposes a way to extend the aspheric surface number to a continuous variable. It is reported that the optimal aspheric surface numbers are achieved through the global optimization for practical lens design problems.

IThB2 • 10:45 a.m.

Recent Discoveries from Nodal Aberration Theory, *Kevin P. Thompson¹*, Tobias Schmid², Pai-Fong Kao³, Jannick P. Rolland^{2,3}; ¹Optical Res. Associates, USA, ²CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, ³Inst. of Optics, Univ. of Rochester, USA. Nodal Aberration Theory (NAT) was discovered in 1977 and was last presented at this conference 25 years ago. This paper presents recent discoveries and why this theory is gaining in relevance for the future.

IThB3 • 11:00 a.m.

Automatic Determination of Optimal Aspheric Placement, *Thomas G. Kuper*, John R. Rogers; Optical Res. Associates, USA. We describe a tool that analyzes the characteristics of an existing lens, and then determines which surfaces should be made aspheric for optimal results. We apply this tool to several problems, and discuss the results.

IThB4 • 11:15 a.m.

Gaussian Quadrature Ray Selection on the Non-Circular Pupil, *Brian J. Bauman¹*, Hong Xiao²; ¹Lawrence Livermore Natl. Lab, USA, ²Univ. of California at Davis, USA. Gaussian Quadrature methods of selecting rays in ray-tracing are derived for centrally-obscured and vignetted apertures, and are generalized for use in arbitrary wavelength bands. These design conditions perform as efficiently as the circular pupil case.

IThB5 • 11:30 a.m.

DOEs for Color Correction in Broad Band Optical Systems: Validity and Limits of Efficiency Approximations, *Markus Seesselberg*, Bernd H. Kleemann; Carl Zeiss AG, Germany. Based on design examples of optical systems with DOEs for color correction, limits of diffraction efficiency approximations are discussed. These formulae enable optical designers to estimate the amount of stray light from unwanted diffraction orders.

OThB • Polishing

Thursday, June 17
10:30 a.m.–12:30 p.m.
Stephen Jacobs; Univ. of Rochester, USA, Presider

OThB1 • 10:30 a.m.

Invited

Polishing Glass—From Basic Investigations to Industrial Applications, *D. Waechter*, R. Zunke, U. Schneider, O. Dambon, F. Klocke; Fraunhofer IPT, Germany. The Fraunhofer IPT investigates the basic interactions in chemical-mechanical polishing of glass. The knowledge is put together in a monitoring system and the fundamental understanding is applied to current issues in full- and sub-aperture polishing.

OThB2 • 11:00 a.m.

Deterministic Computer-Controlled Polishing Process for High-Energy X-Ray Optics, *Gufran S. Khan*, Mikhail Gubarev, Chet Speegle, Brian Ramsey; Marshall Space Flight Ctr., USA. A deterministic computer-controlled polishing process for large X-ray mirror mandrels is presented. Using tool's influence function and material removal rate extracted from polishing experiments, design considerations of polishing laps and optimized operating parameters are discussed.

OThB3 • 11:15 a.m.

Magnetorheological Finishing of Tungsten Carbide Mold Materials, *Christopher Hall¹*, Yuji Horie¹, Paul Dumas¹, Marc Tricard¹, *Michael DeMarco¹*, Masanobu Tsuda², Masato Kasugai²; ¹QED Technologies, USA, ²Fuji Die, Japan. Recent MRF polishing results of Tungsten Carbide (WC) mold materials will be presented. Excellent roughness values are reported, particularly on fine-grained TSJ02 WC, which led to sub-nanometer Ra values.

OThB4 • 11:30 a.m.

UFF Spotting Technique for Studying Polishing Process Conditions for Optical Glasses and Ceramics, *Shai N. Shafir^{1,2}*, Scott Bambrick¹, Paul D. Funkenbusch²; ¹OptiPro System, USA, ²Dept. of Mechanical Engineering, Univ. of Rochester, USA. We report on the use of UltraForm Finishing spot taking technique to study the surface interactions and process parameters with a variety of polishing pads. The work extends from relatively soft glasses to hard ceramics.

**IThB • What's in Your Optical Design and Analysis Toolkit?—
Continued**

IThB6 • 11:45 a.m.

Generalized Coddington Equations for Refractive/Diffractive Hybrid Surfaces, Chunyu Zhao, James H. Burge; College of Optical Sciences, Univ. of Arizona, USA. We derived the generalized Coddington Equations for diffractive/refractive hybrid surfaces by using the general Snell's law and differential ray tracing approach. The Equations are given in two forms: matrix formalism and explicit expressions.

IThB7 • 12:00 p.m.

Withdrawn

IThB8 • 12:15 p.m.

Objective with Suppressed Single Reflexes, Jan Buchheister, Christopher Weth; Carl Zeiss AG, Germany. Using objectives in a reflected light condition can cause undesired reflexes at dielectric transitions. An optimization method to suppress single reflexes by reflecting them out will be shown as well as a design example.

OThB • Polishing—Continued

OThB5 • 11:45 a.m.

The Response of Pitch to Higher Frequency Vibrations, Brigid Mullany, Jonathan Beaman; Univ. of North Carolina at Charlotte, USA. Different grades of polishing pitch were subjected to vibrations with different frequencies (50Hz to 16kHz). Accelerometers monitored the extent to which vibrations pass through the pitch. Only vibrations over the pitch's resonance frequency are attenuated.

OThB6 • 12:00 p.m.

Invited

One Year of Finishing Meter-Class Optics with MRF® at L-3 IOS Brashear Optics, Francois Piché, Andrew R. Clarkson; L-3 IOS Brashear Optics, USA. L-3 IOS Brashear Optics has been using the Q22-2000F, a 2.3-meter class MRF® platform, to figure a series of 0.75-1.8 meter class optics to completion. We describe accomplishments and performance, and demonstrate gains achieved.

NOTES

Key to Authors and Presiders

(Bold denotes Presider of Presenting Author)

- Abraham, Francy—OMB4
Addiego, Chris—IWD2
Aigner, Simon—JMB43
Aikens, David M.—**ITuD3**, OTuA2, OWE
Ammenheuser, Howard S.—OTuD3
Ammons, S. Mark—JMB5
Andonovic, Ivan—IThA6
Ángel, José Andrés—OThA5
Angel, Roger P.—OTuB3
Arasa, Josep—JMB28
Aronstein, David—ITuA1
Arredondo-Vega, Luis M.—JMB14
Asmad, Miguel—JMB17
Atwood, Jenny—IWD1
Avenidaño-Alejo, Maximino—JMB14, **JMB7**
- Bade, Klaus—OTuC6
Baehr-Jones, Tom—IMA1
Bahrami, Mehdi—**ITuA6**
Bailey, Hop—JMB5
Baldwin, Guillermo E.—**JMB17**
Bambrick, Scott—OThB4
Barber, Sam—OWE5
Bates, Rob—**ITuB1**
Bauman, Brian J.—**IThB4**
Beaman, Jonathan—OThB5
Beaucamp, Anthony—OTuB4
Beckley, Amber M.—**IWA5**
Benford, Dominic—JMB41
Benitez, Pablo—**IWB3**, **IWB5**, IWB6
Berger, Uwe—OWC3
Bergeron, Alain—JMB36
Berkner, Kathrin—ITuB2
Beuzit, Jean Luc—OThA1
Biertümpfel, Ralf—OWC1
Biot, Guillermo—IWB6
Black, Matthew L.—**JMB12**
Blanchard, Nathalie—**JMB36**
Bletcher, Warren—OTuC5
Boonruang, Sakoolkan—JMB23
Börret, Rainer—OWC3
Bortz, John C.—**IWB2**
Brady, Gregory R.—**JMB24**
Brasunas, John—JMB42
Bray, Michael—**OMA5**
Brenner, Karl-Heinz—OWC3
Breyre, Daniel—OMC3
Brick, Peter—IMB4
Brown, Thomas G.—IWA5
Bruce, Neil C.—IWD5
Brunner, Robert—IWC5
Buchheister, Jan—I**ThB8**
Bude, Jeffrey D.—OWA5
Burdick, Nathan E.—OTuD3
Burge, James H.—I**ThB6**, **ITuD5**, ITuE3,
OMA, OMA3, OMA7, OTuA4,
OTuB1, OTuB2, OTuB3
Burkhardt, Matthias—IWC5
Bustin, Nicholas—ITuB4
Byrnes, Peter—IWD1
- Cahuc, Olivier—OWA4
Cai, Wenrui—**OMA7**
Cakmakci, Ozan—**IMC1**, OTuD2
Canavesi, Cristina—**ITuC2**
Cassarly, William J.—IWB4, **I**ThA2****
Champreux, Jean-Philippe—**OWA4**
Chartier, Taylor—OWB2
Chaves, Julio—IWB3
Chen, Cheng-Huan—ITuC7
Chen, Chun-Ko—**OTuC3**
Chen, Lei—OWA2
Chen, Liangjun—JMB20
Chen, Sheng-Hui—OTuC3
Chen, Xi—**JMB31**
Chen, Yang—OWD5
Chen, Yi-Chun—OMA6
Cheng, Dewen—**IMC4**
Cheng, Xuemin—**JMB20**
Chevalier, Claude—JMB36
Chipman, Russell—IWA1, IWA2, **IWA4**,
IWA6, JMB29
Choi, Narak—OMB2
Christensen, Eric—**ITuC5**
Chu, Jiyoung—OWE1
Chung, Te-yuan—**JMB23**
Church, Eugene L.—OWE5
Clark, Don A.—JMB12
Clarkson, Andrew R.—OThB6
Cordero-Dávila, Alberto—**JMB39**
Cornelissen, Hugo J.—**ITuC6**
Cotton, Christopher T.—OTuD3
Coughenour, Blake—**JMB5**
Cox, Brian C.—ITuC3
Coyle, Laura E.—OTuA4
Crabtree, Karlton—JMB29
Cruz-Campa, Jose L.—ITuC4
Cumme, Matthias—IWC5
Curatu, Costin E.—**IWA**
- Dainty, Christopher—ITuA6
Dambo, Olaf—OWD5, OThB1
Darbois, Nathalie—OWA4
Darnis, Philippe—OWA4
Daugherty, Brian J.—**IWA2**
Davis, Gregg E.—**OTuD1**
Decker, Manuel—OTuC6
DeFisher, Scott—**JMB13**
de Groot, Peter—OMA1
de la Fuente, Marta—IWB6
DeMarco, Michael—**OThB3**
Demers, Mathieu—JMB36
Desnoyers, Nichola—JMB36
Díaz, José A.—**JMB28**
Díaz-Uribe, Jose R.—JMB9
Díaz-Uribe, Rufino—**JMB14**, JMB7
Dickey, Fred M.—IWC3, JMB22
Diehl, Damon W.—**OTuA**, **OTuD3**
Ding, Quanxin—JMB26, JMB27
Ditchman, Christopher J.—OTuD3
Dobschal, Hans Jürgen—IWC5
- Dodoc, Aurelian—IWD3
Dohlen, Kjetil—OThA1
Domhardt, Andre—**ITuE4**
Dubin, Matt—ITuD5, **OTuA4**, OWC
Dumas, Paul—OThB3
Duparré, Angela—OTuA5
- El Hadi, Kacem—OThA1
Ellis, A. R.—JMB24
Estrada-Silva, Flor C.—IWD5
Evans, Chris—**OMB3**
Evans, Scott C.—ITuC3
Ewbank, Dale E.—**OWC2**
- Fähnle, Oliver—**OWE4**
Fasshauer, Gregory E.—IMC1
Feinberg, Lee—ITuA1
Feit, Michael D.—OWA5
Fernández-Dorado, José—JMB28
Ferrari, Marc—OThA1
Figueiro, Mariana—**IMB3**
Filatov, Anton—ITuC4, OWC4
Forbes, Greg—**JMA1**, OMA8, OTuA6
Foster, Thomas H.—ITuC2
Fournier, Florian—ITuC2, **IWB4**, OTuA6
Frogget, Brent C.—ITuC3
Fuerschbach, Kyle H.—**IMC3**, IWC4
Funck, Max C.—**ITuF3**
Funkenbusch, Paul—JMB10, JMB11, OThB4,
OWD4
- Gansel, Justyna—OTuC6
García-Flores, Perla C.—JMB14, **JMB9**
García-Liévanos, Omar—**JMB38**
Garduño-Mejía, Jesus—IWD5
Gauvin, Michael—IWD
Ghio, Chris—**OThA**
Ghosh, Abhijit—JMB34
Gill, David—OWC4
Glaesemann, G. S.—JMB12, OWB1
Glenn, Paul—IWD4, **OTuB7**
Goncharov, Alexander V.—ITuA6
Gong, Qian—ITuA1, JMB42
Gonzales, Franco—JMB17
González, Juan C.—IWB5
González-García, Jorge—**JMB39**
González-Leal, Juan María—OThA5
González-Utrera, Dulce—JMB7
Goodman, Tim—IWD2
Granados-Agustín, Fermin—JMB6
Greenhalgh, Catherine—I**TuF2**
Gregory, G. Groot—I**WB**
Greivenkamp, John—I**TuA3**
Griesmann, Ulf—**OMA2**, OWA2, OWE1
Grötsch, Stefan—IMB4
Gubarev, Mikhail—OThB2
- Hagopian, John—JMB42
Hall, Christopher—OThB3
Hall, Trevor J.—I**ThA6**

Hamkens, Jan—**OTuD4**
Hansen, Delbert—**OTuC5**
Hargadon, Robin—**OMC3**
Hart, Michael—**JMB5**
Harvey, Andrew R.—**ITuB4**
Harvey, James E.—**OMB2**
Hasenauer, David M.—**ITuB**
Hauser, Karin—**OWE4**
Hedges, Alan—**OTuD1**
Helgert, Michael—**IWC5**
Herfurth, Tobias—**OTuA5**
Herkommer, Alois—**ITuC1**
Herrera, Joel—**OTuB6**
Herriot, Glen—**IWD1**
Herrmann, Hans W.—**ITuC3**
Ho, Chenhung—**ITuC6**
Hoff, Kyle—**OWB1**
Horie, Yuji—**OTHB3**
Horton, Richard F.—**ITuA7**
Howard, Joseph—**IMA, ITuA1, ITuA5, JMB18**
Hua, Hong—**IMC4**
Huang, Bo-Yu—**OTuC3**
Huang, Chao-Chun—**OTuC3**
Hugot, Emmanuel—**OTHa1**

Infante Herrero, Jose M.—**IWB6**
Infante, Jose—**IWB3**
Ishiga, Kenichi—**ITuB5**
Itoh, Kazuyoshi—**OTHa, OTuC1**
Iturbide-Jiménez, Fernando—**JMB40**

Jacobs, Stephen D.—**JMB2, OThB, OWB2, OWF**
Jain, Himanshu—**OMC1**
Jang, Hyun-Jun—**JMB8**
Jared, Bradley H.—**ITuC4, OWC4**
Jeeva, J. B.—**JMB35**

Kao, Pai-Fong—**ITHB2**
Kasugai, Masato—**OTHB3**
Kaufman, Morris I.—**ITuC3**
Kawasaki, Nobuo—**OMC2**
Kaya, Ilhan—**IMC1, OTuD2**
Kaznatcheev, Konstantine—**OWE5**
Kehoe, Michael—**ITuF5**
Kemme, Shanalyn A.—**JMB24**
Khan, Gufran S.—**OTHB2**
Khankhoje, Uday—**IMA1**
Kim, Dae Wook—**OMA7, OTuB2**
Kim, Dae-Chan—**JMB8**
Kim, Joshua J.—**ITuE1**
Kim, Se-Heon—**IMA1**
Kim, Yong H.—**ITuC3**
Kim, Youngsik—**OTuC4**
Kim, Young-Sik—**OTuC5**
Kleemann, Bernd H.—**ITHB5**
Klocke, Fritz—**OWD5, OThB1**
K'nevez, Jean-Yves—**OWA4**
Koshel, R. John—**IMB, IThA4, ITuE1**
Kreischer, Cody B.—**ITuF1**
Krijn, Marcel P. C. M.—**ITuC6**
Krywonos, Andrey—**OMB2**
Ku, Shih-Liang—**OTuC3**
Kubala, Kenneth—**JMA2**
Kuhn, Michael—**IWC1**

Kuhn, William P.—**OMB5**
Kulawiec, Andrew—**OMA8**
Kuper, Thomas G.—**IThB3**

Laheurte, Raynald—**OWA4**
Lam, Wai Sze Tiffany—**IWA1**
Lambropoulos, John C.—**OMC3, OWB2**
Laurence, Ted A.—**OWA5**
Le Noc, Loïc—**JMB36**
Leal Cabrera, Irce—**JMB6**
Lee, Chung-Min—**OMA6**
Lee, El-Hang—**JMB8**
Lee, Ho-Youl—**JMB8**
Lee, Jong Ung—**JMB8**
Lee, Kye-Sung—**IWC2, IWD4**
Lee, Ook-Hee—**JMB8**
Lee, Seung Gol—**JMB8**
Lehan, John P.—**OWE1**
Lehr, Dennis—**IWC5**
Lemaître, Gerard—**OTHa1**
Lentine, Anthony L.—**ITuC4**
Lerner, Scott A.—**IMC**
Levoy, Marc—**ITuB3**
Li, Hongyu—**OTuB4**
Li, Ping—**ITuD8**
Li, Xinghua—**OWB1**
Liang, Chao-Wen—**OMA6, OTuA3**
Liao, Pen-I—**OTuA3**
Light, Brandon—**OWE2**
Lin, Bo-Jhih—**OMA6**
Lin, Donghui—**ITuD8**
Lin, Hung-Yi—**ITuC7**
Lin, Po-Chun—**ITuC7**
Lin, Wang—**IWB6**
Linden, Stefan—**OTuC6**
Liu, Han—**OMC3**
Liu, Hua—**JMB26, JMB27**
Liu, Jiayao—**IWB3**
Liu, Lanqin—**ITuD8**
Livshits, Irina L.—**JMB19**
Lizotte, Todd—**JMB22**
Long, Justin—**OMC3**
Loosen, Peter—**ITuF3**
Luna, Esteban—**OTuB6**

Ma, Haiyan—**ITuC6**
Ma, Jianshe—**JMB20**
Mack, Joseph M.—**ITuC3**
MacMillin, Brian E.—**JMB10, JMB11**
Maffett, Steven P.—**OTHa2**
Malone, Robert M.—**ITuC3**
Mandina, Michael—**OWE2**
Manhart, Paul K.—**IWB1**
Markason, David J.—**ITuD6**
Martel, Anne—**JMB36**
Martin, Robert—**JMB5**
Matsumoto, Yoshihiro—**JMB32**
McClain, Stephen—**IWA1**
McGillivray, Kevin D.—**ITuC3**
McGuire, James P.—**ITuF6**
McKinney, Wayne R.—**OWE5**
Meeder, Mark—**OWE4**
Meemon, Panomsak—**IWD4**
Menapace, Joseph A.—**OWA5**

Merchán Alba, José Fernando—**OWC3**
Miao, Chunlin—**OWB2**
Michaloski, Paul—**ITuC**
Michie, Craig—**IThA6**
Mici, Joni—**OWB2**
Mifsud, Steve—**IWD2**
Miller, Philip E.—**OWA5**
Milster, Thomas—**ITuD4, OTuC4, OTuC5**
Miñano, Juan C.—**IWB3, IWB5, IWB6**
Mo, Lei—**ITuD8**
Montiel, Pierre—**OTHa1**
Moore, Duncan—**ITuC5**
Moore, Kenneth E.—**IThA1**
Moore, Sean A.—**JMB37**
Morita, Tomokazu—**OMC2**
Moseley, S. H.—**JMB41**
Mourad, Safer—**OWE4**
Moyer, Patrick—**OWA3**
Mullany, Brigid—**OTHB5, OTuC, OWA3**
Muñoz, Fernando—**IWB6**
Murali, Supraja—**IWD4**
Murillo, Francisco—**OTuB6**
Murphy, Paul E.—**OMA8**
Muschaweck, Julius A.—**IMB4**

Nakajima, Kousuke—**OMC2**
Nakano, Takayuki—**JMB32**
Nakazawa, Takeshi—**OMB4**
Nasyrov, Ruslan K.—**OTHa4**
Néauport, Jérôme—**OWA4**
Nelson, Jayson—**OWD6**
Nelson, Jessica D.—**OWA, OWB, OWE2, OWF**
Neumann, Cornelius—**ITuE4**
Nicholson, Mark G.—**ITHa1, IThB**
Nielson, Gregory—**ITuC4, OWC4**
Nomura, Akihiro—**OMA4**
Núñez, Manuel—**OTuB6**

O, Beom-Hoan—**JMB8**
O'Donohue, Steven D.—**OTHa2**
Ohmori, Hitoshi—**OWD1**
Okandan, Murat—**ITuC4, OWC4**
Okuno, Takeharu—**IMA2**
Olson, Craig—**IWD2**
Olszak, Artur—**OTHa3**
Omećinski, Steven M.—**OTuD1**
Ozeki, Yasuyuki—**OTuC1**

Pachot, Charlotte—**IWC4**
Palagi, Martin J.—**ITuC3**
Pan, Jui-Wen—**JMB25**
Parent, Jocelyn—**IWD7**
Park, Jong Rak—**OTuC4**
Park, Se-Geun—**JMB8**
Parker, Wesley—**OWA3**
Parks, Robert E.—**ITuE3, OMA7, OTuB3, OWE3**
Pashkovskiy, Matvey A.—**JMB19**
Pasquale, Bert—**ITuA1, JMB41, JMB42**
Patton, Edward—**OWD6**
Percino-Zacarias, Elizabeth—**JMB6**
Pérez-Santos, Carlos—**JMB14**
Peter, Diethard—**JMB43**
Peterson, Gary—**OMB2**
Pfisterer, Richard—**ITuE**

Piché, François—**OTHB6**
 Poleshchuk, Alexander G.—**OTH A4**
 Puget, Pascal—**OTH A1**

Quiroz, Fernando—**OTuB6**

Rademacher, Matt—**JMB5**
 Ramsey, Brian—**OTH B2**
 Ramsey, Jamie L.—**ITH A6**
 Ranjan, Rajeev—**JMB34**
 Rascher, Rolf—**OWD2, OWD3**
 Rea, Mark S.—**IMB1**
 Rehn, Henning—**ITH A5**
 Reichel, Steffen—**OWC1**
 Reimer, Christopher—**ITH A3**
 Richmann, Annika—**OTuC2**
 Rill, Michael S.—**OTuC6**
 Robichaud, Joseph—**OMC4, OTuB**
 Robinson, Michael D.—**ITuB2**
 Roblee, Jeffrey W.—**OTuD1**
 Rodgers, J. Michael—**ITuD1**
 Rogers, John R.—**IMC2, IThB3**
 Roll, Christopher D.—**JMB10, JMB11, OWD4**
 Rolland, Jannick P.—**IMC1, IMC3, IThB2,**
ITuA, ITuC2, IWB4, IWC2, IWC4,
IWD4, OTuA6, OTuB5, OTuD,
OTuD2
 Romanofsky, Henry J.—**OWB2**
 Romeo, Robert—**JMB5**
 Romero, Louis A.—**IWC3**
 Rosete-Aguilar, Martha—**IWD5**
 Rubio-Peña, Luis—**OTH A5**
 Ruckman, Jeffrey L.—**OTH A**
 Ruiz, Elfego—**OTuB6**
 Runkel, Michael J.—**JMB3**
 Ruoff, Johannes—**IWA3**

Saile, Volker—**OTuC6**
 Salas, Luis—**OTuB6**
 Salzman, Sivan—**OWB2**
 Sánchez, Rubén—**JMB17**
 Sandfuchs, Oliver—**IWC5**
 Santiago-Alvarado, Agustín—**JMB40**
 Sasaki, Osami—**OMA4**
 Sasian, Jose—**IMA4, ITuE3, JMB30, OMB4**
 Savage, Daniel—**OWE2**
 Schalck, Robert E.—**JMB15**
 Scherer, Axel—**IMA1**
 Schinhaerl, Markus—**OWD2, OWD3**
 Schmid, Tobias—**ITHB2, IWC2, IWC4, OTuB5**
 Schmidt, Greg—**ITuC5**
 Schneider, Florian—**OWD2, OWD3**
 Schneider, U.—**OTH B1**
 Schröder, Sven—**OTuA5**
 Schwab, Christian—**JMB43**
 Schwalenberg, Simon—**IMB4**
 Seesselberg, Markus—**ITHB5**
 Seppala, Lynn G.—**ITuA2**
 Shafer, David—**IMA3**
 Shafrir, Shai—**JMB13, OMB, OThB4, OWB2,**
OWD4
 Shatz, Narkis—**ITHA, IWB2**
 Shen, Nan—**OWA5**
 Shen, Rui—**OWB2**
 Shorey, Aric B.—**OWD**
 Sidick, Erkin—**JMB1**

Sierchio, Justin—**OTuC4, OTuC5**
 Sinclair, Michael B.—**ITuC4**
 Singh, Megha—**JMB35**
 Sivokon, Victor P.—**ITH A6**
 Skarlinski, Michael—**JMB2, OWB2**
 Smith, Daniel G.—**IWC**
 Smith, Gregory—**IWA1**
 Sohn, Erika—**OTuB6**
 Song, Jong-Sub—**JMB8**
 Sorroche, Francisco—**JMB28**
 Spanò, Paolo—**ITuD2**
 Sparrold, Scott—**JMB16**
 Speegle, Chet—**OTH B2**
 Spencer, Harvey M.—**ITuD7**
 Sperber, Peter—**OWD2, OWD3**
 Stafeev, Sergey K.—**JMB19**
 Stahl, Philip—**ITuA1**
 Steed, David—**ITuA3**
 Steele, William A.—**OWA5**
 Steigner, Peter—**JMB41**
 Steiner, Reinhard—**IWC5**
 Stephenson, David—**ITuD**
 Stoeffl, Wolfgang—**ITuC3**
 Stone, Bryan D.—**ITuA5**
 Su, Jingqin—**ITuD8**
 Su, Peng—**ITuE3, OTuB3**
 Sun, Wen-Shing—**JMB21, JMB33**
 Suratwala, Tayyab—**OMC, OWA1, OWA5**
 Sutorik, Anthony—**OWA6**
 Suzuki, Takamasa—**OMA4**
 Sweatt, William—**ITuC4, OWC4**
 Sykora, Daniel M.—**OMA1**
 Szapiel, Stan—**ITuF2**
 Szwaykowski, Piotr—**OTH A3**

Takacs, Peter Z.—**OWE5**
 Tamagawa, Yasuhisa—**JMB32**
 Tamkin, John M.—**ITuD4, IWC2, OTuC5**
 Thibault, Simon—**IWD7**
 Thiel, Michael—**OTuC6**
 Thompson, Kevin P.—**IMC1, IMC3, IThB2,**
IWC2, IWC4, IWD4, JMA, OTuA6,
OTuB5, OTuD2
 Tibbitts, Aric—**ITuC3**
 Timinger, Andreas—**IMB2**
 Totzeck, Michael—**IWA3**
 Tremblay, Bruno—**JMB36**
 Tricard, Marc—**OTH B3**
 Trost, Marcus—**OTuA5**
 Tsuda, Masanobu—**OTH B3**
 Tsuei, Chih-Hsuan—**JMB21**
 Tucto, Karem—**JMB17**
 Tukker, Teus—**ITuE2**
 Tunnell, Thomas W.—**ITuC3**

Unger, Blair—**ITuC5**
 Utsumi, Akihiko—**ITuB5**

Valdéz, Jorge—**OTuB6**
 Valverde, Juan—**OTH A5**
 van Sprang, Hans A.—**ITuC6**
 Vasilyev, Vladimir N.—**JMB19**
 Vazquez-Montiel, Sergio—**JMB38, JMB40**
 Vettenburg, Tom—**ITuB4**
 Vilaplana, Juan—**IWB6**
 Vizgaitis, Jay N.—**IWD6**

Vlcek, Miroslav—**OMC1**
 Vo, Sophie—**IWC4**
 Voellmer, George—**JMB41**
 Vogt, Christian—**OWD2, OWD3**
 von Freymann, Georg—**OTuC6**
 Vorburger, Theodore—**OMB1**
 Waechter, D.—**OTH B1**
 Walker, David—**OTuB4**
 Wang, Fang—**ITuD8**
 Wang, Fei—**OWD5**
 Wang, Lirong—**ITuE3, JMB30, OTuB3**
 Wang, Mimi—**OWB2**
 Wang, Quandou—**OWA2**
 Wang, Shiguang—**JMB4**
 Wang, Wengyi—**ITuD8**
 Wang, Yongtian—**IMC4**
 Waritanant, Tanant—**JMB23**
 Wegener, Martin—**OTuC6**
 Wendel, Simon—**ITuE4**
 Weth, Christopher—**ITH B8**
 Wiederhold, Robert—**OWE2**
 Wiese, Gary—**ITuF**
 Willenborg, Edgar—**OTuC2**
 Williams, Wesley—**OWA3**
 Wissenbach, Konrad—**OTuC2**
 Wittmer, Volker—**OWC1**
 Wolf, Emil—**IWC2**
 Wong, Lana L.—**OWA5**
 Wood, Andy—**ITuB4**
 Wood, H. John—**OWF1**
 Wormell, Prudence M. J. H.—**OTuA1**
 Wyrowski, Frank—**IWC1**

Xiao, Hong—**ITH B4**

Yabe, Akira—**ITH B1**
 Yadav, Hira L.—**JMB34**
 Yang, Han-Ping—**ITuC7**
 Yang, Hong—**OWB2**
 Yashchuk, Valeriy—**OWE5**
 Yi, Allen Y.—**OWD5**
 Young, Carl S.—**ITuC3**
 Yu, Guoyu—**OTuB4**
 Yun, Garam—**IWA6, JMB29**

Zaverton, Melissa—**OTuC4, OTuC5**
 Zhao, Chunyu—**ITH B6, ITuD5**
 Zhao, Wei—**OWD5**
 Zhou, Ping—**OMA3, OMA7**
 Zhu, Qihua—**ITuD8**
 Zunke, R.—**OTH B1**

International Optical Design Conference (IODC)/ Optical Fabrication and Testing (OF&T) Update Sheet

Agenda of Sessions Update:

In the program book, the rooms were omitted inadvertently from the top of the agenda of sessions for Monday and Tuesday. Please see the reverse of this page for a corrected agenda for Monday and Tuesday.

Withdrawals:

JMB3
JMB19
ITuD2

Key to Authors and Presiders Corrections:

On page 46, presentation IWC2 is attributed to John M. Tamkin, but should be attributed to John Tamkin, Jr.

On page 44, Chris Ghio is incorrectly listed as the presider for session OThA. On page 45, Kazuyoshi Itoh is incorrectly listed as the presider for session OThA. The presider for session OThA is Jeffrey L. Ruckman; Lockheed Martin Missiles and Fire Control, USA.

Presentation Updates: Please see the postdeadline papers book for times and locations of postdeadline paper presentations. Postdeadline papers will be presented throughout the week in various oral sessions as well as in the poster session.

The organizers acknowledge the generous support from the following sponsors:



UNIVERSITY OF CENTRAL FLORIDA
CREOL, THE COLLEGE OF OPTICS AND PHOTONICS



Fabrication, Design and Instrumentation
Technical Division



	IODC Grand Room	IODC Lodge Room, Pavilion	OF&T Teton Room
Sunday, June 13			
3:00 p.m.–6:00 p.m.	Registration Open, Lobby		
Monday, June 14			
7:00 a.m.–6:00 p.m.	Registration Open, Lobby		
8:00 a.m.–9:30 a.m.	JMA • Joint IODC/OF&T Plenary Session		
9:30 a.m.–10:00 a.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
9:30 a.m.–4:30 p.m.	Exhibits Open, Mezzanine-Grand/Lobby		
10:00 a.m.–12:30 p.m.	IMA • Surface Plasmons Plenary, Emerging Technologies and Fundamental Optical Design, and Kidger and Hilbert Award Presentations		OMA • Interferometry
12:30 p.m.–2:00 p.m.	Lunch (on your own)		
2:00 p.m.–4:00 p.m.	IMB • Illumination Engineering: Principles and Practice		OMB • Metrology
4:00 p.m.–4:30 p.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
4:30 p.m.–6:00 p.m.	IMC • Optical Surface Representation and Freeform Design		OMC • Optical Materials
6:00 p.m.–8:00 p.m.	JMB • Joint IODC/OF&T Poster Session, Exhibit Hall, Pavilion		
Tuesday, June 15			
7:30 a.m.–6:00 p.m.	Registration Open, Lobby		
8:00 a.m.–10:00 a.m.	ITuA • Optical Systems I: Telescopes, Binoculars and Reflective Systems		OTuA • Specification and Measurement
10:00 a.m.–10:30 a.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby		
10:00 a.m.–4:30 p.m.	Exhibits Open, Mezzanine-Grand/Lobby		
10:30 a.m.–12:30 p.m.	ITuB • Optical Design for Modern Digital Systems and Computational Imaging (ends at 12:15 p.m.)		OTuB • Large Optics (ends at 12:45 p.m.)
12:30 p.m.–2:00 p.m.	Lunch (on your own)		
2:00 p.m.–4:00 p.m.	ITuC • Design and Applications of Illumination Systems	ITuD • Design and Analysis Considerations for Optical System Fabrication and Testing	OTuC • Laser Writing in Materials
4:00 p.m.–4:30 p.m.	Coffee Break/Exhibits, Mezzanine-Grand/Lobby and Lodge Room, Pavilion		
4:30 p.m.–6:00 p.m.	ITuE • Modeling and Testing of Illuminations Systems and Components	ITuF • Manufacturing Considerations for Optical Design Producibility and Tolerance Desensitization	OTuD • Freeform Optics
6:00 p.m.–7:30 p.m.	Joint Conference Reception, Atrium		
7:00 p.m.–8:00 p.m.	Memorial Program, Grand Room		

IODC Postdeadline Presentations

• Monday, June 14, 2010 •

Exhibit Hall, Pavilion

6:00 p.m.–8:00 p.m.

JMB • Joint IODC/OF&T Poster Session

JMB44P

Design of Freeform Lenses for Illumination, Nikolai I. Petrov, Georgy Tananaev, Emil Aslanov; LG Technology Ctr., Moscow, Russian Federation. Reflective and refractive type of lenses for LED emitting into circle and square illumination areas are proposed. Lens surface profiles for extended sources are obtained from the solution of the first order differential equations.

JMB45P

Measurement and Characterization of Dimpled Planar Light Guide Prototypes, Michael Brown, Duncan Moore, Greg Schmidt, Blair Unger; Inst. of Optics, Univ. of Rochester, USA. A dimpled light guide solar concentrator has been manufactured, and measurements of this prototype have been successfully modeled to predict performance. A second generation prototype was manufactured with 70% optical efficiency at 60x geometric concentration.

JMB46P

Concentrated Photovoltaic Stepped Planar Light Guide, Duncan Moore, Greg R. Schmidt, Blair Unger; Inst. of Optics, Univ. of Rochester, USA. A stepped planar light guide concentrated photovoltaic system is presented. The guide design prevents trapped light from being rejected at other injection facets. Concentration in the guide is 112.5x.

• Tuesday, June 15, 2010 •

Grand Room

8:00 a.m.–10:00 a.m.

ITuA • Optical Systems I: Telescopes, Binoculars and Reflective Systems

Jannick P. Rolland; Inst. of Optics, Univ. of Rochester, USA, Presider

ITuA4P • 9:00 a.m.

Current Concept for the 4-m European Solar Telescope (EST) Optical Design, Jorge Sánchez-Capuchino¹, Manuel Collados¹, Dirk Soltau², Roberto López¹, José Luis Rasilla¹, Bernard Gelly³; ¹Inst. de Astrofísica de Canarias (IAC), Spain, ²Kiepenheuer-Inst. für Sonneophysik (KIS), Germany, ³THEMIS, France. EST is a pan-European project for a 4-meter class solar telescope conceptual design. Its concept integrates optical transfer stages assembling AO-MCAO with optical field de-rotation being time and wavelength invariant in terms of polarization.

Grand Room

4:30 p.m.–6:00 p.m.

ITuE • Modeling and Testing of Illuminations Systems and Components

Richard Pfisterer; Photon Engineering, LLC, USA, Presider

ITuE5P • 5:45 p.m.

Dimpled Planar Lightguide Solar Concentrators, Blair L. Unger, Greg R. Schmidt, Duncan T. Moore; Inst. of Optics, Univ. of Rochester, USA. Lightguide concentrators show tremendous promise for thin form-factor, lightweight, and inexpensive replacements for the current generation of refractive and reflective solar concentrators. We propose a new type of structure for reducing optical losses and dramatically increasing the practical upper limit on concentration within micro-structured lightguide concentrators.

IODC Postdeadline Presentations—Continued

• Tuesday, June 15, 2010 •

Lodge Room, Pavilion

4:30 p.m.–6:00 p.m.

ITuF • Manufacturing Considerations for Optical Design Producibility and Tolerance Desensitization

Gary Wiese; Lockheed Martin Corp., USA, Presider

ITuF4P • 5:15 p.m.

HHG Beam Wavefront Measurement by XUV PDI Sensor, Pavel Homer, Bedrich Rus, Jan Hřebíček, Michaela Kozlová, David Snopek; Inst. of Physics AS CR, v. v. i., Czech Republic. We performed measurement of the XUV HHG (High Harmonics Generation) beam wavefront by the PDI (Point Diffraction Interferometer) sensor recently. We will discuss obtained results as well as design and setup of the PDI sensor.

• Wednesday, June 16, 2010 •

Grand Room

8:00 a.m.–10:00 a.m.

IWA • Polarization in Optical Design

Costin E. Curatu; Alcon Labs, USA, Presider

IWA7P • 9:45 a.m.

Stress Birefringence for Extended Depth of Focus Imaging, Thomas G. Brown, Amber M. Beckley; Inst. of Optics, Univ. of Rochester, USA. A stressed element with sixfold symmetry can apodize a pupil with a superposition of positive and negative spherical aberrations. The point spread function for this system shows two marginal foci symmetrically separated from the paraxial focus, offering the possibility of using this type of element for extended depth of focus imaging.

• Thursday, June 17, 2010 •

Grand Room

10:30 a.m.–12:45 p.m.

IThB • What's in Your Optical Design and Analysis Toolkit?

Mark G. Nicholson; ZEMAX Development Corp., USA, Presider

IThB7P • 12:00 p.m.

Calculation of Third-Order Misalignment Aberrations with the Optical Plate Diagram, Andrew Rakich; Large Binocular Telescope Observatory, USA. The Optical Plate diagram has been generalized to allow the calculation of third-order misalignment aberrations for axially-symmetrical optical systems. This method simplifies third-order analysis, yielding useful insight into asymmetric field aberrations in perturbed optical systems.

IThB9P • 12:30 p.m.

Optical Configuration for the VNS Spectrometer of the EarthCARE Multi-Spectral Imager Instrument, Oana van der Togt¹, Rob Vink¹, Isabel Escudero-Sanz²; ¹TNO, Netherlands, ²European Space Agency ESTEC SRE-PAI, Netherlands. We present the optical configuration of an imaging filter spectrometer, part of the European Space Agency Multi-Spectral Imager instrument, that will provide information on the clouds for a better understanding of Earth climate.

OF&T Postdeadline Presentations

• Monday, June 14, 2010 •

Exhibit Hall, Pavilion

6:00 p.m.–8:00 p.m.

JMB • Joint IODC/OF&T Poster Session

JMB47P

Application of the NANOMEFOS Non-Contact Measurement Machine in Asphere and Freeform Optics Production, Rens Henselmans, Guido Gubbels, Casper van Drunen; TNO Science & Industry, Netherlands. The NANOMEFOS machine is capable of fast, non-contact, universal measurement of aspheres and freeforms, up to $\text{Æ}500$ mm with an uncertainty below 30 nm (2σ). It is now being applied in optics production at TNO.

• Wednesday, June 16, 2010 •

Teton Room

6:00 p.m.–8:00 p.m.

OWF • Student Awards Ceremony and H. John Wood Presentation

Jessica DeGroot Nelson; Optimax Systems Inc., USA; and Stephen Jacobs; Univ. of Rochester, USA, Presiders

OWF2P • 7:30 p.m.

Fabrication and Test of Spherical Primary Optical Telescope (SPOT) Segments, John Hagopian, Jason Budinoff, Bruce Dean, Joseph Howard, Carl Strojny; NASA Goddard Space Flight Ctr., USA. Spherical primary telescopes are cost effective for large segmented apertures. The SPOT segments are cast in pyrex and shaped to allow radius of curvature control. This paper discusses design, fabrication and performance of SPOT segments.

OWF3P • 7:45 p.m.

Modeling of Deformed Segmented Mirrors in Grazing Incidence Telescopes, Martina Atanassova, Timo Saha, William Zhang; NASA Goddard Space Flight Ctr., USA. This work shows an approach for modeling “as-fabricated” and “as-mounted” segmented mirrors in grazing incidence telescopes. The model is used to balance the impact of fabrication/mount deformations with segment alignment in the final telescope.

Key to Authors and Presiders

(Bold denotes Presider of Presenting Author)

Aslanov, Emil—JMB44P

Atanassova, Martina—**OWF3P**

Beckley, Amber M.—IWA7P

Brown, Michael—**JMB45P**

Brown, Thomas G.—IWA7P

Budinoff, Jason—OWF2P

Collados, Manuel—ITuA4P

Curatu, Costin—IWA

Dean, Bruce—OWF2P

Escudero-Sanz, Isabel—IThB9P

Gelly, Bernard—ITuA4P

Gubbels, Guido—JMB47P

Hřebíček, Jan—ITuF4P

Hagopian, John—**OWF2P**

Henselmans, Rens—**JMB47P**

Homer, Pavel—**ITuF4P**

Howard, Joseph—OWF2P

Jacobs, Stephen—**OWF**

Kozlová, Michaela—ITuF4P

López, Roberto—ITuA4P

Moore, Duncan—ITuE5P, JMB45P, JMB46P

Nelson, Jessica DeGroot—**OWF**

Nicholson, Mark G.—**IThB**

Petrov, Nikolai I.—**JMB44P**

Pfisterer, Richard—**ITuE**

Rakich, Andrew—**IThB7P**

Rasilla, José Luis—ITuA4P

Rolland, Jannick—**ITuA**

Rus, Bedrich—ITuF4P

Saha, Timo—OWF3P

Sánchez-Capuchino, Jorge—**ITuA4P**

Schmidt, Greg R.—ITuE5P, JMB45P, **JMB46P**

Snopek, David—ITuF4P

Soltau, Dirk—ITuA4P

Strojny, Carl—OWF2P

Tananaev, Georgy—JMB44P

Unger, Blair L.—**ITuE5P**, JMB45P, JMB46P

van der Togt, Oana—**IThB9P**

van Drunen, Casper—JMB47P

Vink, Rob—IThB9P

Wiese, Gary—**ITuF**

Zhang, William—OWF3P