

SPIE.OPTIFAB



OPTIFAB TECHNICAL PROGRAM.

Conference & Courses
12-15 October 2015

Exhibition
13-15 October 2015

Rochester Riverside
Convention Center
Rochester, New York, USA

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Rochester Riverside Convention Center

Rochester, New York, USA

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Univ. of
Rochester (USA)

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OptoTech
Optikmaschinen
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(Germany)

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- Kirk J. Warden**, LaCroix Optical Co. (USA)
- Robert Anton Wiederhold**, Optimax Systems, Inc. (USA)

PLENARY PRESENTATIONS

3D Printing of Optics: The Manufacturing of Polymer Optics via Inkjet Printing

Tuesday 13 October • 8:00 to 8:45 am • Location: Highland A/B



Joris Biskop

LUXeXceL Group BV (Netherlands)

Via a digital design (CAD-file) the optical design is converted into a print file. These drive the inkjet printhead inside of the manufacturing printer, this printhead ejects droplets of a specially developed monomer mixture that is sensitive to UV light, in the specific coordinates defined by the converted design. These droplets are cured via UV light and form a solid layer, this process is repeated until an 3D printed optic emerges.

LUXeXceL has developed this technology that they can produce parts, accurately, transparent, smooth and at production speeds.

Also discussed: The design for manufacturing, the optical parameters, and the part quality.

Joris Biskop currently CTO of LUXeXceL Brought two generations of inkjet printers to market and led pioneer work in optimizing acrylic materials for use in inkjet technology. Author and inventor on 5 patents.

Laser Polishing of Glass

Tuesday 13 October • 8:45 to 9:30 am • Location: Highland A/B



Christian Weingarten

Fraunhofer-Institut für Lasertechnik (Germany)

The manufacturing of nonspherical optics in small lot sizes is time consuming and hence more expensive compared to the manufacturing of spheres. But, since nonspherical optics exhibit several advantages the demand for aspheres is steadily increasing. With laser processing, a decoupling of work piece and tool geometry is achieved, which enables the manufacturing time being nearly independent from the optics geometry.

A laser based process chain for optics manufacturing, which is being developed at the Fraunhofer ILT

Generally, each process step for optics manufacturing can be conducted with laser radiation. However, each process step can be used

PLENARY PRESENTATIONS

as self-standing process and hence implemented in a conventional process chain.

To manufacture an optic with laser radiation three laser based process steps are consisted in the process chain. In a first step the geometry is generated from a glass preform. Using a CO₂-Laser material is ablated by evaporation.

The second step of the Laser based process chain is the Laser Polishing for reducing the resulting roughness of the high speed laser ablation. For Laser Polishing, CO₂ laser radiation is used due to the high absorption coefficient of glass at $\lambda = 10.6 \mu\text{m}$ of about 80%. The laser radiation is absorbed in a thin surface layer with a thickness in fused silica of $\sigma_{\text{opt}} < 10 \mu\text{m}$. Hence, the thin layer of the glass surface can be heated up just below evaporation temperature. Due to the surface tension and the reduced viscosity the roughness can flow out.

To reduce the resulting waviness of the polishing step a third process step is necessary. First, the surface is measured and subsequently the shape deviation is reduced by a High Precision Laser Ablation step. For the form correction CO₂—or ultra-short pulse laser radiation is used.

In the presentation results for all three steps with a focus on laser polishing will be shown.

Christian Weingarten studied material science at the RWTH Aachen University in Germany (2008 – 2013). Since November 2013 he has been doing his doctorate at the Fraunhofer Institute for Laser Technology in Aachen. His research interest in the field of laser material processing include the laser polishing as well as the development of a laser based process chain for manufacturing of optics.

Kidger Scholarship Award

Tuesday 13 October · 9:30 to 9:40 am · Location: Highland A/B



Tina Kidger, Kidger Optics, will present the Michael Kidger Memorial Scholarship in Optical Design to Eric Schiesser, University of Rochester. This scholarship is supported by the Michael Kidger Memorial Scholarship fund in memory of Michael John Kidger, a well-respected educator, design software developer and member of the optical science and engineering community.

For more information on the Michael Kidger Memorial Scholarship, visit www.kidger.com.

SPECIAL EVENTS

Ribbon Cutting Ceremony

Tuesday 13 October from 9:45 to 10:00 am

Location: Empire Hall Lobby

Join the Honorable Lovely Warren, Mayor of Rochester, New York, for a Ribbon Cutting Ceremony to open the Optifab 2015 Exhibition on Tuesday 13 October at 9:45 am in the Empire Hall lobby.

17th Annual Photonics Clambake

Tuesday 13 October · 5:30 pm

Location: Hyatt Ballroom

Tickets are sold separately

Attendees and Exhibitors are welcome to attend. Limited space available.

Contact Michael Naselaris, Sydor Optics, Inc. for tickets at Booth #510.



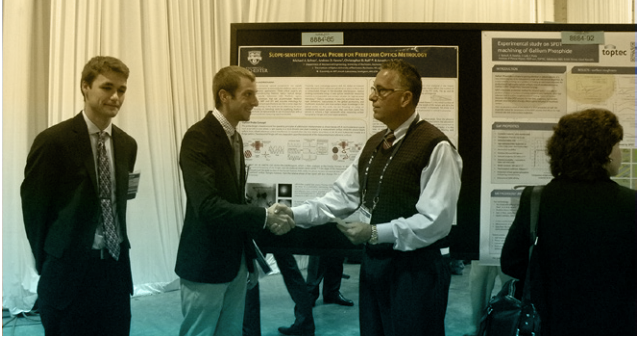
PRESENTED BY: **SYDOR**
OPTICS

POWER - Photonics and Optics Workforce Education Research Overview

Wednesday 14 October 2015 · 9:15 to 9:45 am · Location: Highland C

The Photonics and Optics Workforce Education Research (POWER) project is serving as an in-depth case study to expand national discussions about general STEM skills into a focused understanding of the needs for a specific STEM industry. To do this study, we are interviewing and surveying entry level employees, their managers, and human resource directors to explore the skills they find valuable in their work. We are starting with an analysis across the Rochester region inclusive of both technician and engineering positions across a range of companies. For those seeking employment, we want to help them better understand the broader set of technical and non-technical skills used on the job. For higher education, we hope this research informs the ways that courses integrate the actual skills used in industry. For companies, this study provides a mechanism to communicate their changing workforce needs with institutions of higher education. We hope this project facilitates discussion across students, higher education, and employers to strengthen preparation toward optics and photonics careers.

SPECIAL EVENTS



SPIE Optifab Job Fair

Wednesday 14 October · 10:00 am to 6:00 pm

Location: Exhibition Hall

Top employers are coming together to interview and hire candidates at SPIE Optifab 2015. Bring your resume to the Exhibition Hall and start your future.

SPONSORED BY: **SPIE Career Center**

Networking Reception and Poster Viewing

Wednesday 14 October · 4:30 to 6:00 pm

Location: Exhibition Hall

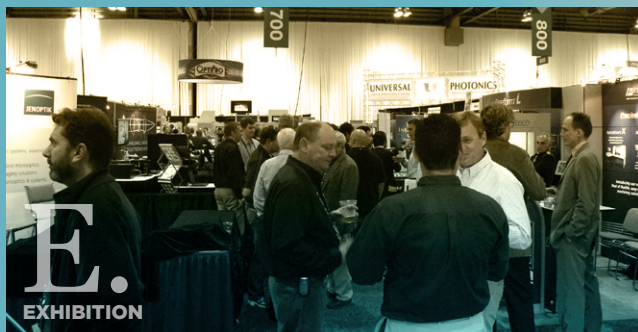
Symposium attendees are invited to attend the Poster/Networking Reception on Wednesday evening in the Empire Hall. The reception provides an opportunity for attendees to meet with colleagues, network, view poster papers, and interact with the authors. Refreshments will be served.

Attendees are required to wear their badges.

PANEL DISCUSSION

Optics and Photonics Education in Rochester: Strategies for Advanced Education to Support Growth, Innovations, and Future Jobs

Wednesday 14 October · 3:30 to 4:30 pm • Location: Highland A/B



OPTIFAB EXHIBITION.

EXHIBITION DAYS AND TIMES

Tuesday 13 October10:00 am to 5:00 pm

Wednesday 14 October10:00 am to 6:00 pm

Poster Reception/Networking . . . 4:30 pm to 6:00 pm

Thursday 15 October10:00 am to 3:00 pm

Experience North America's premier optical fabrication show

Walk the floor and see cutting-edge technologies in optical design and fabrication, broaden your professional network, and accelerate your research and production improvements.

Free seminars on the show floor give you a valuable opportunity to learn new methods, improve your processes, cut costs, and discuss your requirements face-to-face.

EXHIBITION CHAIRS



Michael Naselar
Sydor Optics,
Inc. (USA)



Justin J. Mahanna
Universal
Photonics,
Inc. (USA)



Richard Nastasi
Universal
Photonics,
Inc. (USA)

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DAILY EVENT SCHEDULE

MONDAY 12 October	TUESDAY 13 October
MORNING SESSIONS	
<p>SESSION 1: Grinding and Polishing Processes I 8:00 to 10:00 am</p>	<p>PLENARY PRESENTATIONS: 3D Printing of Optics: The Manufacturing of Polymer Optics via Inkjet Printing (Joris Biskop) 8:00 to 8:45 am</p> <p>Laser Polishing of Glass (Christian Weingarten) 8:45 to 9:30 am</p>
<p>SC1039: Evaluating Aspheres for Manufacturability 8:30 am to 12:30 pm</p>	<p>SC700: Understanding Scratch and Dig Specifications 8:30 am to 12:30 pm</p>
<p>SC1169: Optical Manufacturing Fundamentals New 8:30 am to 5:30 pm</p>	<p>SC1122: Applying Freeform Optical Surfaces in Imaging Optics New 8:30 am to 5:30 pm</p>
	<p>Kidger Scholarship Award 9:30 to 9:40 am</p>
	<p>Exhibition Ribbon Ceremony Opening Ceremony · 9:45 am</p>
	<p>Coffee and Exhibition Break · 10:00 am</p>
	<p>EXHIBITION — Walk the floor and see the latest in optical fabrication technologies 10:00 am to 5:00 pm</p>
<p>SESSION 2: Grinding and Polishing Processes II 10:30 am to 12:10 pm</p>	<p>SESSION 5: Optical Design 10:30 am to 12:30 pm</p>

DAILY EVENT SCHEDULE

WEDNESDAY 14 October	THURSDAY 15 October
MORNING SESSIONS	
SESSION 8: Freeform I 8:00 to 10:00 am	SESSION 12: Metrology II 8:00 to 10:00 am
SC1017: Optics Surface Inspection Workshop 8:30 am to 12:30 pm	SC1011: Making Sense of Waviness and Roughness on Optics 8:30 am to 12:30 pm
	SC1170: The Very Least You Need To Know About Optics  8:30 am to 5:30 pm
	POWER - Photonics and Optics Workforce Education Research Overview 9:15 to 9:45 am
10:00 am to 6:00 pm JOB FAIR 10:00 am to 6:00 pm	10:00 am to 3:00 pm
SESSION 9: Freeform II 10:30 am to 12:10 pm	SESSION 13: Metrology III 10:30 am to 12:30 pm

DAILY EVENT SCHEDULE

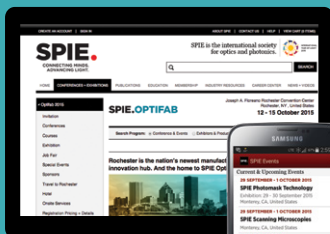
MONDAY 12 October	TUESDAY 13 October
AFTERNOON SESSIONS	
SC1153: A Practical Guide to Specifying Optical Components 1:30 to 5:30 pm <div style="float: right; border: 1px solid black; border-radius: 50%; padding: 2px; color: white; font-weight: bold;">New</div>	SC720: Cost-Conscious Tolerancing of Optical Systems 1:30 to 5:30 pm
SC1167: Gradient Index (GRIN) Optical Design 1:30 to 5:30 pm	
SESSION 3: Grinding and Polishing Processes III 1:30 to 3:30 pm	SESSION 6: Fabrication and Testing of Mirrors 1:40 to 3:20 pm
SESSION 4: Grinding and Polishing Processes IV and Metrology I 4:00 to 6:00 pm	SESSION 7: Optical Engineering 3:50 to 5:10 pm
	17th Annual Photonics Clambake 5:30 pm <i>(Admission by ticket only)</i>

SPIE and APOMA would like to express its deepest appreciation to the symposium chairs, conference chairs, program committees, session chairs, and authors who have so generously given their time and advice to make this symposium possible.

The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members. This program is based on commitments received up to the time of publication and is subject to change without notice.

DAILY EVENT SCHEDULE

WEDNESDAY 14 October	THURSDAY 15 October
AFTERNOON SESSIONS	
<p>SC015: Fastening Optical Elements with Adhesives 1:30 to 5:30 pm</p>	<p>SC1171: Seeing, Analyzing and Controlling Mid-Spatial Frequency (MSF) and Surface Roughness Errors on Optical Surfaces, 1:30 to 5:30 pm New</p>
<p>SC1168: Specifying and Mitigating Laser Damage New 1:30 to 5:30 pm</p>	
<p>SESSION 10: Diamond Turning and Molded Optics 1:40 to 3:00 pm</p>	
<p>PANEL DISCUSSION Optics and Photonics Education in Rochester: Strategies for Advanced Education to Support Growth, Innovations, and Future Jobs 3:30 to 4:30 pm</p>	
<p>Networking Reception and Poster Viewing, 4:30 to 6:00 pm</p>	



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Visit the Job Fair in the Exhibition Hall
Wednesday 14 October • 10:00 am to 6:00 pm



CORNING

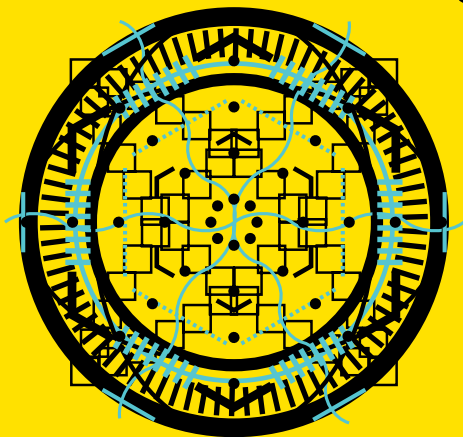
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Standards which are widely recognized as standards of good practice.

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

COURSES

MONDAY

- SC1039 **Evaluating Aspheres for Manufacturability** (Dumas, Murphy)
Course Level: Introductory, CEU: 0.35, 8:30 am to 12:30 pm,
\$360 / \$410
- SC1169 **Optical Manufacturing Fundamentals** (Williamson)
Course Level: Introductory, CEU: 0.65, 8:30 am to 5:30 pm,
\$600 / \$690
-  SC1153 **A Practical Guide to Specifying Optical Components** (Youngworth)
Course Level: Introductory, CEU: 0.35, 1:30 pm to 5:30 pm,
\$360 / \$410
- SC1167 **Gradient Index (GRIN) Optical Design** (Moore) Course Level:
Intermediate, CEU: 0.35, 1:30 pm to 5:30 pm, \$360 / \$410



TUESDAY

- SC1122 **Applying Freeform Optical Surfaces in Imaging Optics**
(Rolland, Rolland-Thompson) Course Level: Intermediate,
CEU: 0.65, 8:30 am to 5:30 pm, \$570 / \$660
- SC700 **Understanding Scratch and Dig Specifications** (Aikens) Course Level:
Introductory, CEU: 0.35, 8:30 am to 12:30 pm, \$430 / \$480
- SC720 **Cost-Conscious Tolerancing of Optical Systems** (Youngworth)
Course Level: Introductory, CEU: 0.35, 1:30 pm to 5:30 pm,
\$360 / \$410

WEDNESDAY

- SC1017 **Optics Surface Inspection Workshop** (Aikens) Course Level:
Introductory, CEU: 0.35, 8:30 am to 12:30 pm, \$440 / \$490
- SC015 **Fastening Optical Elements with Adhesives** (Daly) Course Level:
Intermediate, CEU: 0.35, 1:30 pm to 5:30 pm, \$360 / \$410
- SC1168 **Specifying and Mitigating Laser Damage** (McGuire) Course Level:
Introductory, CEU: 0.35, 1:30 pm to 5:30 pm, \$360 / \$410

THURSDAY

- SC1011 **Making Sense of Waviness and Roughness on Optics** (Aikens)
Course Level: Intermediate, CEU: 0.35, 8:30 am to 12:30 pm,
\$480 / \$530
-  SC1170 **The Very Least You Need To Know About Optics** (Diehl) Course Level:
Introductory, CEU: 0.35, 8:30 am to 12:30 pm, \$225 / \$275
-  SC1171 **Seeing, Analyzing and Controlling Mid-Spatial Frequency (MSF)
and Surface Roughness Errors on Optical Surfaces** (DeGroot
Nelson) Course Level: Introductory, CEU: 0.35, 1:30 pm to 5:30 pm,
\$360 / \$410

CONFERENCE 9633

Monday–Thursday 12–15 October 2015
Proceedings of SPIE Vol. 9633

Optifab 2015

Conference Chairs: **Julie L. Bentley**, Univ. of Rochester (USA); **Sebastian Stoebenau**, OptoTech Optikmaschinen GmbH (Germany)

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MONDAY 12 OCTOBER

SESSION 1

Location: Highland A/B Mon 8:00 am to 10:00 am

Grinding and Polishing Processes I

Session Chair: **Jessica DeGroot Nelson**, Optimax Systems, Inc. (USA)

8:00 am: **The impact of layer thickness on the performance of additively manufactured lapping tools**, Wesley B. Williams, The Univ. of North Carolina at Charlotte (USA) [9633-1]

8:20 am: **Nano alumina slurries for improved polishing on thermoset and thermoplastic resins**, Abigail R. Hooper, Christopher Boffa, Harry W. Sarkas, Nanophase Technologies Corp. (USA) [9633-2]

8:40 am: **The effect of diamond powder characteristics on polishing of sintered silicon carbide**, Ben Rosczyk, Eric Burkam, Engis Corp. (USA); Artem Titov, Clement Onyenemezu, Ion Benea, Engis Corp (USA) . [9633-3]

9:00 am: **Advanced zirconia-coated carbonyl-iron particles for acidic magnetorheological finishing of chemical-vapor-deposited ZnS and other IR materials**, Sivan Salzman, Luccas J. Giannechini, Henry J. Romanofsky, Nicholas Golini, Brittany N. Taylor, Stephen D. Jacobs, John C. Lambropoulos, Univ. of Rochester (USA) [9633-4]

9:20 am: **Comparison of various colloidal silica slurries and process parameters for fused silica finishing**, Sebastien Campaignolle, Cedric Maunier, Jérôme Néauport, Commissariat à l'Énergie Atomique (France) [9633-5]

9:40 am: **Material removal mechanism and material removal rate model of CMP process for quartz glass using soft particle**, Defu Liu, Guanglin Chen, Qing Hu, Central South Univ. (China) [9633-6]

Coffee Break Mon 10:00 am to 10:30 am

CONFERENCE 9633

SESSION 2

Location: Highland A/B Mon 10:30 am to 12:10 pm

Grinding and Polishing Processes II

Session Chair: **Michael J. Bechtold**, OptiPro Systems (USA)

10:30 am: **Process for repairing large scratches on fused silica optics**, Philippe Cormont, Antoine Bourgeade, Sandy Cavaro, Commissariat à l'Énergie Atomique (France); Thomas Doualle, Institut Fresnel (France); Gael Gaborit, Commissariat à l'Énergie Atomique (France); Laurent Gallais, Institut Fresnel (France); Jean-Luc Rullier, Daniel Taroux, Commissariat à l'Énergie Atomique (France) [9633-7]

10:50 am: **Industrial characterization of nano-scale roughness on polished surfaces**, Nikolaj A. Feidenhans'l, Technical Univ. of Denmark (Denmark) and Danish Fundamental Metrology Institut (Denmark); Poul-Eric Hansen, Danish Fundamental Metrology Institut (Denmark); Lukáš Pilný, Technical Univ. of Denmark (Denmark); Morten H. Madsen, Danish Fundamental Metrology Institut (Denmark); Giuliano Bissacco, Technical Univ. of Denmark (Denmark); Jan C. Petersen, Danish Fundamental Metrology Institut (Denmark); Rafael J. Taboryski, Technical Univ. of Denmark (Denmark) [9633-8]

11:10 am: **Deterministic polishing from theory to practice**, Abigail R. Hooper, Nathan Hoffmann, Harry W. Sarkas, Nanophase Technologies Corp. (USA); John Escolas, Zachary Hobbs, Sydor Optics, Inc. (USA) [9633-13]

11:30 am: **Reduced cost and improved figure of sapphire optical components**, Mark Walters, Kevin Bartlett, Matthew R. Brophy, Jessica DeGroote Nelson, Kate Medicus, Optimax Systems, Inc. (USA) [9633-14]

11:50 am: **Precision machining of optical surfaces with subaperture correction technologies MRF and IBF**, Olaf Schmelzer, Roman Feldkamp, JENOPTIK Optical Systems GmbH (Germany) [9633-11]

Lunch Break Mon 12:10 pm to 1:30 pm

SESSION 3

Location: Highland A/B Mon 1:30 pm to 3:30 pm

Grinding and Polishing Processes III

Session Chair: **Sebastian Stoebenau**,
OptoTech Optikmaschinen GmbH (Germany)

1:30 pm: **Considerations in the evaluation and correction of mid-spatial frequency surface features**, Paul E. Murphy, Christopher A. Hall, QED Technologies, Inc. (USA) [9633-9]

1:50 pm: **Fine figure correction and other applications using novel MRF fluid designed for ultra-low roughness**, Chris Maloney, QED Technologies, Inc. (USA) [9633-10]

2:10 pm: **Developments in precision asphere manufacturing**, Jayson Tierson, Edward Fess, Greg Matthews, OptiPro Systems (USA) [9633-15]

2:30 pm: **Reproducible and deterministic production of aspheres**, Ernst Michael Leitz, Carsten Stroh, Fabian Schwalb, Satisloh GmbH (Germany) [9633-16]

2:50 pm: **Processing of high aperture optics**, Matthias Pfaff, Roland Mandler, OptoTech Optikmaschinen GmbH (Germany) . . . [9633-17]

3:10 pm: **Satisloh centering technology developments past to present**, Ernst Michael Leitz, Steffen Moos, Satisloh GmbH (Germany) . . . [9633-18]

Coffee Break Mon 3:30 pm to 4:00 pm

SESSION 4

Location: Highland A/B Mon 4:00 pm to 6:00 pm

Grinding and Polishing Processes IV and Metrology I

Session Chair: **Matthias Pfaff**,
OptoTech Optikmaschinen GmbH (Germany)

4:00 pm: **Ultrasonic precision optical grinding technology**, Michael J. Cahill, Michael J. Bechtold, Edward Fess, Frank L. Wolfs, Rob Bechtold, OptiPro Systems (USA) [9633-19]

4:20 pm: **Femtosecond laser polishing of optical materials**, Lauren L. Taylor, Rochester Institute of Technology (USA); Jun Qiao, Rochester Institute of Technology (USA) and The University of Science and Technology Liaoning (China); Jie Qiao, Rochester Institute of Technology (USA) [9633-20]

CONFERENCE 9633

4:40 pm: **Smoothing of optical surface corners by abrasive polishing with a plate spring**, Hideo Takino, Yusuke Saito, Kazuya Tsuji, Naoki Mouri, Chiba Institute of Technology (Japan) [9633-21]

5:00 pm: **Gabor-domain optical coherence microscopy with integrated dual-axis MEMS scanner for fast 3D imaging and metrology**, Cristina Canavesi, LightTopTech Corp. (USA); Andrea Cogliati, Adam Hayes, Univ. of Rochester (USA); Anand P. Santhanam, Univ. of California, Los Angeles (USA); Patrice Tankam, Jannick P. Rolland, Univ. of Rochester (USA) [9633-22]

5:20 pm: **Thickness estimation with optical coherence tomography and statistical decision theory**, Jinxin Huang, Univ. of Rochester (USA); Jianing Yao, University of Rochester (USA); Nicholas M. Cirucci, Univ. of Rochester (USA); Trevor Ivanov, University of Rochester (USA); Jannick P. Rolland, Univ. of Rochester (USA) [9633-23]

5:40 pm: **Optomechanics of handheld probes with galvanometer scanners for biomedical and industrial imaging. Applications in OCT**, Virgil-Florin Duma, Aurel Vlaicu Univ. of Arad (Romania) and Politehnica Univ. of Timisoara (Romania) and Univ. of West Timisoara (Romania); George M. Dobre, Univ. of Kent (United Kingdom); Dorin Demian, Aurel Vlaicu Univ. of Arad (Romania); Cosmin Sinescu M.D., Meda Lavinia Negrutiu M.D., Univ. of Medicine and Pharmacy Victor Babes Timisoara (Romania); Ramona C. Cernat, Univ. of Kent (United Kingdom); Gheorghe M. Hutiu, Aurel Vlaicu Univ. of Arad (Romania); Adrian Bradu, Univ. of Kent (United Kingdom); Jannick P. Rolland, Univ. of Rochester (USA); Adrian G. H. Podoleanu, Univ. of Kent (United Kingdom) [9633-24]



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TUESDAY 13 OCTOBER

PLENARY SESSION

Location: Highland A/B Tue 8:00 to 9:30 am

8:00 to 8:45 am

3D Printing of Optics: The Manufacturing of Polymer Optics via Inkjet Printing



Joris Biskop
LUXeXcel Group BV (Netherlands)

8:45 to 9:30 am

Laser Polishing of Glass



Christian Weingarten
Fraunhofer-Institut für Lasertechnik (Germany)

KIDGER SCHOLARSHIP AWARD

Location: Highland A/B 9:30 am to 9:40 am



Tina E. Kidger will present the Michael Kidger Memorial Scholarship to Eric Schiesser, University of Rochester.

EXHIBITION RIBBON CUTTING OPENING CEREMONY

Location: Empire Hall Lobby Tue 9:45 am to 10:00 am

COFFEE AND EXHIBITION BREAK

Location: Empire Hall Tue 10:00 am to 10:30 am

CONFERENCE 9633

SESSION 5

Location: Highland A/B Tue 10:30 am to 12:30 pm

Optical Design

Session Chair: **Richard N. Youngworth**, Riyo LLC (USA)

10:30 am: **Early considerations in lens specification to aid later manufacturing**, Brandon B. Light, Optimax Systems, Inc. (USA) . . [9633-25]

10:50 am: **Global optimization and desensitization**, John R. Rogers, Synopsys, Inc. (USA) [9633-26]

11:10 am: **Optical design constraints for the successful fabrication and testing of aspheres**, Dave Stephenson, Jay Kumler, JENOPTIK Optical Systems, LLC (USA) [9633-27]

11:30 am: **Cost-driven self-consistent fabrication and assembly tolerance classes**, Kevin P. Thompson, Synopsys, Inc. (USA); Jannick P. Rolland, University of Rochester, Institute of Optics (USA) [9633-28]

11:50 am: **Fabrication of EUVL micro-field exposure tools with 0.5 NA**, Luc Girard, Louis A. Marchetti, Mark Bremer, Jim Kennon, Bob Kestner, Sam Hardy, Zygo Corporation (USA) [9633-98]

12:10 pm: **An XML file format for exchanging singlet lens specifications**, Shawn C Gay, Sanjay Gangadhara, Zemax LLC (USA) [9633-30]

Lunch / Exhibition Break Tue 12:30 pm to 1:40 pm

SESSION 6

Location: Highland A/B Tue 1:40 pm to 3:20 pm

Fabrication and Testing of Mirrors

Session Chair: **Paul Dumas**, QED Technologies, Inc. (USA)

1:40 pm: **The manufacturing and metrology of off-axis mirrors**, Karlheinz Penzkofer, Rolf Rascher, Lutz Küpper, Johannes Liebl, Hochschule Deggendorf Technologiecampus Teisnach (Germany) [9633-31]

2:00 pm: **Advances in diamond generating for 8.4 meter telescope mirrors**, Jonathan M. Davis, Hubert M. Martin, Dae Wook Kim, Adrian R. Loeff, Kurt L. Kenagy, Raymond W. Sisk, Jeffery Hagen, The Univ. of Arizona (USA) [9633-32]

2:20 pm: **Lightweight mirror construction optimization**, James T. Mooney, Eric A. Lintz, Roger J. Dahl, Mark A. Allen, James Bolton, Exelis Inc. (USA) [9633-33]

2:40 pm: **A method to diagnose and combat index of refraction non-uniformity in evaporative optical coatings**, Joel Bagwell, Edmund Optics Inc (USA); Chris Cook, Craig Ament, Edmund Optics Inc. (USA) . . [9633-55]

LOCATION: HIGHLAND A/B

3:00 pm: **Polishability of thin electrolytic and electroless NiP layers**, Jan Kinast, Matthias Beier, Andreas Gebhardt, Stefan Risse, Ramona Eberhardt, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) [9633-35]
Coffee Break Tue 3:20 pm to 3:50 pm

SESSION 7

Location: Highland A/B Tue 3:50 pm to 5:10 pm

Optical Engineering

Session Chair: **Theodore Tienvieri**, Corning Tropol Corp. (USA)

3:50 pm: **Assembly strategies using alignment turning**, Christian Buß, Aleksej Baier, Trioptics GmbH (Germany) [9633-36]

4:10 pm: **Fabrication of metal mirror modules for snap together VIS telescopes**, Matthias Beier, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Johannes Hartung, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Jan Kinast, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Andreas Gebhardt, Stefan Risse, Ramona Eberhardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Friedrich-Schiller-Univ. Jena (Germany) [9633-37]

4:30 pm: **Strategies for active alignment of lenses**, Patrik Langehanenberg, Josef Heinisch, Christian Wilde, Felix Hahne, Bernd Lueerss, TRIOPTICS GmbH (Germany) [9633-38]

4:50 pm: **Optimization of sub-cells orientation for assembly of a high-quality transmission sphere**, Wei-Jei Peng, Cheng-Fong Ho, Zong-Ru Yu, Chien-Yao Huang, Ching-Hsiang Kuo, Wei-Yao Hsu, Instrument Technology Research Ctr. (Taiwan) [9633-39]

17th Annual Photonics Clambake

Tuesday 13 October • 5:30 pm • Tickets are sold separately

Attendees and Exhibitors are welcome to attend. Limited space available. Contact Michael Naselaris, Sydor Optics, Inc. for tickets at Booth #510.

PRESENTED BY: The logo for SYDOR OPTICS features the word 'SYDOR' in a large, bold, black serif font. Above the letters 'Y', 'D', 'O', and 'R' are the letters 'S', 'T', 'E', and 'F' respectively, in a smaller, spaced-out font. Below 'SYDOR' is the word 'OPTICS' in a smaller, black, sans-serif font. A horizontal rainbow-colored bar is positioned between 'SYDOR' and 'OPTICS'.

CONFERENCE 9633

WEDNESDAY 14 OCTOBER

SESSION 8

Location: Highland A/B Wed 8:00 am to 10:00 am

Freeform I

Session Chair: **Dave Stephenson**, JENOPTIK Optical Systems, Inc. (USA)

8:00 am: **Coma full-field display for freeform imaging systems**, Aaron M. Bauer, Univ. of Rochester (USA); Kevin P. Thompson, Synopsys, Inc. (USA) and Univ. of Rochester (USA); Jannick P. Rolland, Univ. of Rochester (USA) [9633-40]

8:20 am: **Why are freeform telescopes less alignment sensitive than a traditional unobscured TMA?**, Kevin P. Thompson, Synopsys, Inc. (USA) and Univ. of Rochester (USA); Eric Schiesser, The Institute of Optics, Univ. of Rochester (USA); Jannick P. Rolland, Univ. of Rochester (USA) [9633-41]

8:40 am: **Importance of fiducials on freeform optics**, Matthew J. Brunelle, Joe Yuan, Kate Medicus, Jessica DeGroot Nelson, Optimax Systems, Inc. (USA) [9633-42]

9:00 am: **Strategy for non-contact freeform measurements with a cylinder coordinate measuring instrument**, Andreas Beutler, Mahr GmbH (Germany) [9633-43]

9:20 am: **Freeform metrology using swept-source optical coherence tomography with custom pupil-relay precision scanning configuration**, Jianing Yao, Di Xu, Jannick P. Rolland, Univ. of Rochester (USA) . [9633-44]

9:40 am: **Systematic error analysis for 3D nanoprofiler tracing normal vector**, Ryota Kudo, Yusuke Tokuta, Motohiro Nakano, Kazuya Yamamura, Katsuyoshi Endo, Osaka Univ. (Japan) [9633-45]

Coffee Break Wed 10:00 am to 10:30 am

SESSION 9

Location: Highland A/B Wed 10:30 am to 12:30 pm

Freeform II

Session Chair: **Jannick P. Rolland**, Univ. of Rochester (USA)

10:30 am: **New developments in the manufacture of large freeform surfaces with micro-structures**, Jeffrey W. Roblee, Mark Walter, Ben Jacobs, AMETEK Precitech, Inc. (USA) [9633-46]

10:50 am: **A-cylinder and freeform optical manufacturing**, Edward Fess, Frank L. Wolfs, Scott DeFisher, James Ross, OptiPro Systems (USA). [9633-47]

LOCATION: HIGHLAND A/B

- 11:10 am: **New opportunities in freeform manufacturing using a long stroke fast tool system and integrated metrology**, Frank Niehaus, Stephan Huttenhuis, Thomas Danger, Schneider GmbH & Co. KG (Germany) [9633-48]
- 11:30 am: **Deterministic form correction of extreme freeform optical surfaces**, Timothy P. Lynch, Brian W. Myer, Kate Medicus, Jessica DeGroot Nelson, Optimax Systems, Inc. (USA) [9633-49]
- 11:50 am: **Freeform grinding and polishing with PROSurf**, Frank L. Wolfs, Edward Fess, Scott DeFisher, Josh Torres, James Ross, OptiPro Systems (USA) [9633-50]
- 12:10 pm: **Heraeus Fused Silica Opaque Diffuser Materials: HOD500**, Robert M. Sawyer, Frank Nuernberg, Heraeus Tenevo, LLC (USA) [9633-104]
- Lunch / Exhibition Break Wed 12:30 pm to 1:40 pm

SESSION 10

Location: Highland A/B Wed 1:40 pm to 3:00 pm

Diamond Turning and Molded Optics

Session Chair: **Jonathan D. Ellis**, Univ. of Rochester (USA)

- 1:40 pm: **Surface finish in ultra-precision diamond turning of single-crystal silicon**, Michael Ayomoh, Khaled Abou-El-Hosseini, Nelson Mandela Metropolitan Univ. (South Africa) [9633-51]
- 2:00 pm: **Diamond grooving of rapidly solidified optical aluminium**, Khaled Abou-El-Hosseini, Nelson Mandela Metropolitan Univ. (South Africa); Wei-Yao Hsu, National Applied Research Labs. (Taiwan); Sameh Ghobashy, Nelson Mandela Metropolitan Univ. (South Africa); Ching-Hsiang Kuo, National Applied Research Labs. (Taiwan); Zwelinzima Mkoko, Nelson Mandela Metropolitan Univ. (South Africa) [9633-52]
- 2:20 pm: **Novel method for fabrication of monolithic multi cavity molds and wafer optics**, Marc Wielandts, Rémi Wielandts, Wielandts UPMT s.a. (Belgium) [9633-53]
- 2:40 pm: **Precision lens molding of asphero diffractive surfaces in chalcogenide materials**, Jayson J. Nelson, Michael Scordato, Katie Schwertz, Joel Bagwell, Edmund Optics Inc. (USA) [9633-54]
- Coffee Break Wed 3:00 pm to 3:30 pm

PANEL DISCUSSION

Location: Highland A/B Wed 3:30 pm to 4:30 pm

**Optics and Photonics Education in Rochester:
Strategies for Advanced Education to Support
Growth, Innovations, and Future Jobs**

CONFERENCE 9633

POSTERS WEDNESDAY

Location: Empire Hall Wed 4:30 pm to 6:00 pm

Symposium attendees are invited to attend the Poster/Networking Reception on Wednesday evening in the Empire Hall. The reception provides an opportunity for attendees to meet with colleagues, network, view poster papers, and interact with the authors. Refreshments will be served.

Attendees are required to wear their conference registration badges.

A new and easy coating of transparent magnetite, zinc oxide, and titanium dioxide for lens tinting, Anisse Chiali, EPST Tlemcen (Algeria); Nassera Ghellai, Univ. Abou Bekr Belkaid Tlemcen (Algeria) [9633-70]

Finite element analysis to evaluate optical mirror deformations, Rafael Izazaga-Pérez, Daniel Aguirre-Aguirre, Brenda Villalobos-Mendoza, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . [9633-71]

Design and fabrication of x-ray mirror for producing vortex beam, Takahiro Saito, Yoko Takeo, Hidekazu Mimura, The Univ. of Tokyo (Japan) [9633-72]

Pixelated filters for spatial imaging, Karine Mathieu, Ctr. National d'Études Spatiales (France); Michel Lequime, Institut Fresnel (France) and Aix-Marseille Univ. (France) and Ecole Centrale Marseille (France); Julien Lumeau, Institut Fresnel (France) and Ecole Centrale Marseille (France) and Aix-Marseille Univ. (France); Laëtitia Abel-Tibérini, Institut Fresnel (France) and Aix-Marseille Univ. (France) and Ecole Centrale Marseille (France); Isabelle Savin De Larclause, Jacques Berthon, Ctr. National d'Études Spatiales (France) [9633-74]

Fabrication of resonator-QWIP FPA by inductively coupled plasma etching, Jason N. Sun, Kwong-Kit Choi, Kimberley Olver, U.S. Army Research Lab. (USA) [9633-75]

Laser diode: a fascinating application of nanotechnology, Arshad Mahmood, National Institute of Lasers & Optronics (Pakistan) . . . [9633-76]

Cutting and shaping operations for optical glasses, Rafael Izazaga-Pérez, Daniel Aguirre-Aguirre, Esperanza Carrasco-Licea, María-Elizabeth Percino-Zacarías, Fermin-Salomon Granados-Agustín, Brenda Villalobos-Mendoza, Noe Lopez-Hernandez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Valentin Lopez-Cortes, INAOE (Mexico); Jose T. Quechol-Lopez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) [9633-77]

Ultra precision machining technique of off-axis optics for coastal water remote sensing, MinWoo Jeon, SangWon Hyun, Korea Basic Science Institute (Korea, Republic of); JeongYeol Han, Korea Astronomy and Space Science Institute (Korea, Republic of); GeonHee Kim, Korea Basic Science Institute (Korea, Republic of) [9633-78]

Freeform correction polishing for optics with semi-kinematic mounting, Chien-Yao Huang, Ching-Hsiang Kuo, Wei-Jei Peng, Zong-Ru Yu, Cheng-Fong Ho, Ming-Ying Hsu, Wei-Yao Hsu, Instrument Technology Research Ctr. (Taiwan) [9633-79]

Recent progress in bound-abrasive polishing of fused silica glass, Yaguo Li, Chengdu Fine Optical Engineering Research Ctr. (China)[9633-80]

Metrology system for inter-alignment of lasers, telescopes, and mechanical datum, Oren Aharon, Duma Optronics Ltd. (Israel); Itai Vishnia, PLX Inc. (USA) [9633-82]

Compact wavefront diagnosis system based on the randomly encoded hybrid grating, Tong Ling, Dong Liu, Yongying Yang, Xiumei Yue, Zhejiang Univ. (China); Jiabin Jiang, Zhejiang University (China) [9633-84]

Adaptive position detection method of optical vortex using a Shack-Hartmann wavefront sensor, Jia Luo, Zhejiang Univ. (China); Hongxin Huang, Yoshinori Matsui, Haruyoshi Toyoda, Takashi Inoue, Hamamatsu Photonics K.K. (Japan); Jian Bai, Zhejiang Univ. (China) [9633-85]

Z axis deviation angle measurement of electro-optic crystal by conoscopic interference, Dong Li, Yong Liu, Liu Xu, Hongzhen Jiang, Fanglan Zheng, China Academy of Engineering Physics (China) . . [9633-87]

Ptychographic phase retrieval method for characterizing ultra-precise ellipsoidal mirrors, Yoko Takeo, Takahiro Saito, Hidekazu Mimura, The Univ. of Tokyo (Japan). [9633-88]

Reverse optimization reconstruction method in non-null aspheric interferometry, Lei Zhang, Dong Liu, Tu Shi, Yongying Yang, Shiyao Chong, Yibing Shen, Jian Bai, Zhejiang Univ. (China). . . . [9633-89]

Homodyne displacement measuring interferometer probe for optical coordinate measuring machine with tip and tilt sensitivity, Sam Butler, Michael A. Ricci, Chen Wang, Univ. of Rochester (USA); Qun Wei, Univ. of Rochester (USA) and Changchun Institute of Optics, Fine Mechanics and Physics (China); Jonathan D. Ellis, Univ. of Rochester (USA) [9633-90]

A fast testing method and instrument for surface roughness, Xiaojie Li, Kai Zhao, Northeast Institute of Geography and Agroecology (China) [9633-91]

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Retrieval of phase distributions from the quadriwave lateral shearing interferogram obtained by randomly encoded hybrid grating, Tong Ling, Yongying Yang, Dong Liu, Xiumei Yue, Zhejiang Univ. (China); Jiabin Jiang, Zhejiang University (China) [9633-92]

Aspheric surface reconstruction from curvature data along two orthogonal directions, ByoungChang Kim, SeoungWon Lee, Kyungnam Univ. (Korea, Republic of); Geon-Hee Kim, Sangwon Hyun, Korea Basic Science Institute (Korea, Republic of) [9633-93]

Correction of vibration induced errors in phase shifting interferometry, Piotr Szwaykowski, Apre Instruments (USA) [9633-95]

Holographic sensors for water quality, Sabad-e Gul, Dublin Institute of Technology (Ireland); Anastasia Khartchenko, Ecole Nationale Supérieure d'Ingenieurs de Caen et Ctr. de Recherche (France); Monika Zawadzka, Suzanne M. Martin, John Cassidy, Dublin Institute of Technology (Ireland); Svetlana Mintova, Ecole Nationale Supérieure d'Ingenieurs de Caen et Ctr. de Recherche (France); Izabela Naydenova, Dublin Institute of Technology (Ireland) [9633-96]

Optimization of polyetherimide processing parameters for optical interconnect applications, Wei Zhao, Peter Johnson, SABIC (USA); Christopher Wall, SABIC Innovative Plastics (USA) [9633-97]

Cerium Oxide Polishing Slurry Reclamation Project: characterization techniques and results, Kameron Tinkham, Tess Jacobs, Univ. of Rochester (USA); Mark Mayton, Flint Creek Resources, Inc. (USA); Zachary Hobbs, Sydor Optics, Inc. (USA); Kenneth Marshall, Stephen Jacobs, Univ. of Rochester (USA) [9633-99]

Fabrication of a bioinspired nanoplasmonic structures by diatoms: Nitzschia Palea, Ahmadrza Hajiaboli, Jonathan Hiltz, Mark P. Andrews, McGill Univ. (Canada) [9633-100]

A new error compensation strategy on Laser Displacement Sensor in free-form surface measurement, Bin Sun, Bing Li, Xi'an Jiaotong Univ. (China) [9633-101]

Polishing performances of different optics with different size powder and different pH value slurries during CMP polishing, Jun Cao, Chaoyang Wei, Shijie Liu, Aihuan Dun, Minghong Yang, Xueke Xu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) . [9633-102]

The simulation of workpieces' surface in polishing, Lunzhe Wu, Shanghai Univ. (China); Xueke Xu, Minghong Yang, Chaoyang Wei, Shijie Liu, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) [9633-103]

LOCATION: EMPIRE HALL AND HIGHLAND A/B

THURSDAY 15 OCTOBER

SESSION 12

Location: Highland A/B Thu 8:00 am to 10:00 am

Metrology II

Session Chair: **Michael A. Marcus**, Lumetrics, Inc. (USA)

8:00 am: **Validation of accuracy and repeatability of UltraSurf metrology on common optical shapes**, Scott DeFisher, Greg Matthews, Edward Fess, OptiPro Systems (USA) [9633-58]

8:20 am: **Comparison of relay zoom and changing transmission spheres to change the lateral magnification of a Fizeau interferometer**, Gary M. DeVries, Paul E. Murphy, Jon F. Fleig, QED Technologies, Inc. (USA) [9633-59]

8:40 am: **Fast optical 3D form measurement of aspheres including determination of thickness and wedge and decenter errors**, Erik Stover, AMETEK Precitech, Inc. (USA); Gernot Berger, AMETEK Taylor Hobson GmbH (Germany); Jürgen Petter, AMATEK Taylor Hobson GmbH (Germany) [9633-60]

9:00 am: **A simple device for sub-aperture stitching of fast convex surfaces**, Daniel Aguirre-Aguirre, Rafael Izazaga-Pérez, Brenda Villalobos-Mendoza, Esperanza Carrasco-Licea, Fermin-Salomon Granados-Agustín, María-Elizabeth Percino-Zacarías, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) [9633-61]

9:20 am: **Non-null annular subaperture stitching interferometry for aspheric test**, Lei Zhang, Dong Liu, Tu Shi, Yongying Yang, Shiyao Chong, Zhejiang Univ. (China); Liang Miao, Wei Huang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences Changchun (China); Yibing Shen, Jian Bai, Zhejiang Univ. (China) [9633-62]

9:40 am: **Model-based phase shifting interferometer**, Dong Liu, Lei Zhang, Tu Shi, Yongying Yang, Shiyao Chong, Zhejiang Univ. (China); Liang Miao, Wei Huang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences Changchun (China); Yibing Shen, Jian Bai, Zhejiang Univ. (China) [9633-63]

Coffee Break Thu 10:00 am to 10:30 am

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SESSION 13

Location: Highland A/B Thu 10:30 am to 12:30 pm

Metrology III

Session Chair: **Kate Medicus**, Optimax Systems, Inc. (USA)

10:30 am: **Optical measurement of materials and lens assemblies at specific or varied temperatures**, John J. Nemecek, Metrology Concepts LLC (USA) [9633-64]

10:50 am: **Recent developments in IR metrology using quadri wave lateral shearing interferometry**, William Boucher, Guillaume Bourgeois, Maxime Deprez, Etienne Homassel, Benoit F. Wattellier, PHASICS S.A. (France) [9633-65]

11:10 am: **Automated full-field range OPD and MTF measurement bench for automotive objective benchmark**, William Boucher, Manuel Yonnet, Antoine Gascon, Djamel Brahmi, Benoit F. Wattellier, PHASICS S.A. (France); O. Lavergne, Renault Technocentre (France) [9633-66]

11:30 am: **Metrology of achromatic diffractive features on chalcogenide lenses**, Michael Scordato, Jayson Nelson, Katie Schwertz, Patrick Mckenna, Joel Bagwell, Edmund Optics (USA) [9633-67]

11:50 am: **Multimodal characterization of contact lenses**, Michael A. Marcus, David C. Compertore, Donald S. Gibson, Lumetrics, Inc. (USA); Matthew E Herbrand, Lumetrics Inc (USA); Filipp V. Ignatovich, Lumetrics, Inc. (USA) [9633-68]

12:10 pm: **Spherical aberration standards and measurement system stability over time**, David C Compertore, Lumetrics Inc (USA); Filipp V. Ignatovich, Michael A. Marcus, Lumetrics, Inc. (USA) [9633-69]



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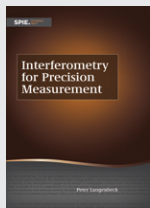
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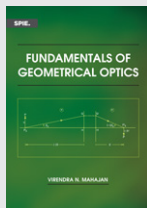


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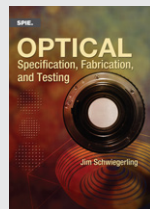


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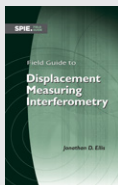
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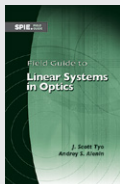
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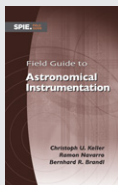
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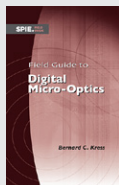
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