SPIE. Professional

JULY 2017

Katarina Svanberg

SPIE GOLD MEDAL

SPIE. Professional

Volume 12, Number 3 (ISSN 1817-4035)

Lidar image courtesy of Luminar.

Features

Send returns and materials to SPIE Professional,
P.O. Box 10, Bellingham, WA 98227-0010 USA.

Cover photo courtesy *Sune Svanberg*

SPIE. Professional

The Member Magazine of SPIE
spie.org/spieprofessional

Managing Editor
Kathy Sheehan
kathys@spie.org
+1-360-685-5538

Graphic Artist
Carrie Binschus

Contributors
Eugene Arthurs, Pascale Barnett, Rachel Berkowitz, Carrie Binschus, Andrew Brown, Ford Burkhart, Stacey Crockett, Michael Eismann, Zakya Kafafi, Eric Lochridge, Amy Nelson, Kathy Sheehan, Sune Svanberg, and Karen Thomas.

Editorial Advisory Board
James G. Grote, chair, US Air Force Research Lab; Kristen Maitland, Texas A&M University; Jason M. Eichenholz, Open Photonics

2017 SPIE President
Glenn Boreman

SPIE CEO
Eugene G. Arthurs

SPIE Director of Education and Community Services
Krisinda Plenkovich

SPIE Director of Publications
Eric Pepper

Advertising Sales
Melissa Farlow
melissaf@spie.org
+1-360-685-5596

Volume 12, Number 3 SPIE Professional (ISSN 1817-4035) is published quarterly by SPIE, 1000 20th St., Bellingham, WA 98225-6705 USA.

Send returns and materials to SPIE Professional, P.O. Box 10, Bellingham, WA 98227-0010 USA.

A few thoughts on optics education

Optics is a bit of a funny academic discipline. It is different from electrical engineering, mechanical engineering, or physics in that most of the faculty in departments that grant degrees in optics do not have degrees directly in the field.

This diversity of backgrounds is healthy to be sure, but it can have its drawbacks in terms of the faculty as a whole agreeing on a required core curriculum, particularly in graduate programs.

The way that graduate study is funded, at least in the USA, is that the faculty pay the students' stipends (and lots of other expenses) out of their research grants. So when a department goes looking for a new tenure-track faculty member, the search committee is pretty strongly focused on the candidate's potential for acquiring research funding.

Now, most researchers are specialists in a fairly restricted area, which is completely understandable given the depth of knowledge required for success in today's hyper-competitive funding environment. Human nature being what it is, most people think their specialty is pretty important. But, it needs to be recognized that optics, as its own separate field, has certain distinctive knowledge components that the community — particularly in industry — expects from someone with a degree in optics.

PREPARING FOR JOB IN INDUSTRY

It seems a legitimate employer expectation that a job candidate with an AS, BS, MS, or PhD in optics has a good facility with lasers as well as a working knowledge of one of the standard design codes and a solid background in such mundane and old-fashioned topics as geometrical optics, radiometry, interferometry, and Fourier optics.

I have heard geometrical optics called trivial in faculty meetings more than enough times. It is indeed simple if all you do is scratch the surface, but when you look in more detail, it is so complex that you barely know where to begin. Sometimes, even the simple aspects can be a little non-intuitive.

A graduate with a degree in optics who cannot explain the utility of an extender tube in a camera or make a depth-of-field estimate looks a bit ill prepared.

If we were solely training future academicians, then we could afford to be more narrow and cutting-edge in our choice of required topics. However, educators should recognize that most of our students will not be employed in the academic sector as there simply are not enough positions to go around. And many actually seek out the challenges and opportunities that come with a job in today's high-tech industries.

NARROW VS. BROAD EDUCATION

And we should perhaps remember that having an optics degree, or especially a few of them, can be somewhat restrictive in terms of employment.

In my experience, if the employer is looking specifically for a person with an optics background, then your resume rises near the top of the pile. But if the employer is looking for someone with a less specific background, then good luck.

The fact that optics is a specialty discipline within physical science and engineering makes it all the more desirable that people coming out of school with optics degrees have the right background.

OPTICS AND PHOTONICS ACCREDITATION

SPIE has a leading role to play in the continuing progress for the recognition of optics as a separate and distinct engineering discipline. Our representation to and participation with ABET, the engineering and technology accreditation board in the USA, is a good example of this.

SPIE was the scientific society co-lead that worked with ABET to establish and formalize distinct optics and photonics criteria for the accreditation of undergraduate degree programs in optical and photonics engineering.

Since the criteria were adopted in 2014, US programs undergoing accreditation review have benefited from evaluation measures specific to our discipline, rather than to engineering in general. Students, faculty, and employers can now be confident that a program meets the quality standards that produce graduates prepared to enter a global workforce.

This year at ETOP, the international conference on Education and Training in Optics and Photonics, participants from the US, China, Singapore, Canada, and elsewhere shared some of the common issues and considerations for optics educators pursuing university accreditation in their countries.

One challenge has been the considerable amount of student mobility among educational institutions across the globe and the lack of coordinated accreditation standards between countries. Reliable, compatible, and recognized standards for all optics and photonics programs would streamline international student transfers between universities and ensure that each program provides graduates with the technical and professional skills expected by employers of optical engineers everywhere.

JOB TITLE: OPTICAL ENGINEER

On a recent visit to NASA Jet Propulsion Lab, I was pleased to see that its human-resources department has a separate position and title for optical engineer. They have the right idea there, and it should be the rule rather than the exception.

I was even happier to know (but not surprised) that both of my PhD graduates who work there have that title.

I look forward to meeting more SPIE members during the year. At whatever conference we are together, please come up and say hello. ■

Glenn Boreman, 2017 SPIE President

SPIE GOLD MEDAL

Katarina Svanberg

Knitting together a winning combination of optics and oncology

Photo by Sune Svanberg

SPIE. **AWARDS**

Gold Medal of the Society

The highest honor SPIE bestows. In recognition of outstanding accomplishments in optics, electro-optics, or photographic technologies or applications.

On the small Swedish island of Ven, classes are beginning for the International Graduate Summer School in Biophotonics. In one classroom, students file in while their instructor, dressed in her trademark linen pantsuit and colorful silk scarves, is knitting — her favorite activity during rare moments of spare time.

The instructor is SPIE Fellow Katarina Svanberg, professor and chief consultant of oncology at Lund University Hospital (Sweden), and professor at South China Normal University. Svanberg is well known as an expert in both optics and oncology, specifically in the area of laser light interactions with biological tissue.

For her contributions to biophotonics, Svanberg is the recipient of the 2017 SPIE Gold Medal. The award recognizes her clinical work exploring and verifying the efficacy of phototherapy and in vivo diagnosis in treating cancer patients.

"All the teachers were charismatic and engaging," writes Jacqueline Andreozzi, who attended the Ven program in 2015 and blogged about it on the Photonics for a Better World blog. "But one of the highlights for me personally was the lecture by Dr. Katarina Svanberg where she conveyed her clinical experience in cancer treatment."

In the lecture, Andreozzi says, Svanberg pointed out that, "we have responsibilities as scientists to be strategic in our research," and she emphasized the humanitarian potential of our work in medicine, as well as the scope of health issues that impact people around the world.

"She is a truly inspiring individual, with a kind heart, sharp wit, and admirable outlook regarding her fellow citizens of this world," Andreozzi writes.

Svanberg was instrumental in helping found the highly regarded International Graduate Summer School in Biophotonics on Ven.

SPIE Fellow Peter Andersen of Technical University of Denmark (DTU) and SPIE member Stefan Andersson-Engels, who moved from Lund University to Tyndall National Institute (Ireland) in 2016, launched the program in 2003 in a collaboration between DTU and Lund University. SPIE is now a cosponsor.

During the biennial, weeklong program, Svanberg makes sure her students learn not only the relevant biological and medical background of biomedical optics, but also that a clinical collaborator needs to learn and understand some of the physics and techniques "knitted" into the research.

Keeping the medical community involved with the science and engineering community is an ongoing challenge, says SPIE CEO Eugene Arthurs.

As Sweden's leading oncologist working with medical lasers, "Dr. Svanberg played a major role in building SPIE biomedical programs, particularly in Europe," Arthurs says. Because she is a practicing clinician, Svanberg's leadership role in SPIE conferences and journals has lent strong and crucial credibility to those programs. "Her ideas, encouragement, and participation contribute to the very successful BiOS, the largest element of Photonics West," Arthurs says.

> "She is a truly inspiring individual, with a kind heart, sharp wit, and admirable outlook regarding her fellow citizens of this world."
>
> **–Jacqueline Andreozzi**

Courtesy ICTP

Svanberg frequently attends the ICTP Winter College on Optics.

DESIGNING THE DREAM

As a child in the small town of Mariestad (Sweden), Svanberg dreamed of becoming a doctor, perhaps influenced by her parents, who both grew up poor and lost young siblings because of a lack of proper medications.

Although neither of her parents went beyond 6th grade in school, they worked hard to ensure that their only child, Katarina, would attend university.

"My mother had always wanted to study, but her situation did not allow that," Svanberg says, "so she told me that she worked hard to let me study instead of her."

Svanberg's mother, who ran a yarn shop, also instilled in her daughter a lifelong love for designing and knitting clothing. This penchant for design would later play an important role in Svanberg's ability to develop new medical procedures.

At the University of Gothenburg (GU), instead of medicine, Svanberg studied history and literature and became a high school teacher. Soon after starting

Continued on page 6 ▶

◀ *Continued from page 9*

her teaching career, she married a PhD candidate in physics, Sune Svanberg. Sune Svanberg would later serve on the Nobel Committee for Physics.

Katarina Svanberg taught high school for some years, eventually gaining a high-level position as a lead teacher, but the dream of studying medicine did not fade. She eventually decided to make her dream a reality, left her teaching job, and applied for medical studies at GU.

To help support the family, Svanberg gave lectures in economic history at night and studied medicine during the day.

"After all," Svanberg jokes, "I had married a scientist who worked around the clock, so I had a lot of time to spend."

She also found the time to have two daughters, Emilie and Kristina.

A NET OF MEDICAL COLLABORATION

She received her MD at GU in 1984.

After Sune Svanberg transferred to Lund University for a professorship in physics, Katarina started her PhD program in medical science and studied laser light interaction in biological tissue.

Both Svanbergs had begun to consider the possibility of combining his knowledge of physics and her medical background while Katarina was still in medical school. The use of lasers in medicine came up — in particular photodynamic therapy (PDT), which entails using photosensitizing agents and light to kill cancer cells.

They studied current literature in the biophotonics field, which Svanberg notes was "infinitely less" than today, almost 35 years later. Working with the oncology division at Lund University Hospital, Svanberg conducted the first clinical PDT session in April 1987.

She earned her PhD in 1989 with a thesis in medical science that presented pre-clinical research work in experimental photodynamic therapy and tissue spectroscopy.

Over the years, the Svanbergs met with clinical heads from internal medicine to brain surgery and began the process of establishing the Lund University Medical Laser Centre. The center was officially inaugurated in 1991 to coordinate research and teaching in the field of laser applications in medicine.

Photo courtesy Eugene Arthurs

Katarina Svanberg and South China Normal University student Wansha Li work with a spectroscopic setup.

Katarina Svanberg and African colleagues treat a patient with photodynamic therapy in Dakar, Senegal, as part of a Swedish/African network for developing countries.

"Together we were able to transfer our ideas to clinical use," Svanberg says. "We developed both the PDT therapy as well as early cancer detection with me as a kind of spider in the complicated net of medical collaboration."

Their equipment for fluorescence-based tumor imaging was used not only at Lund University Hospital but was also taken to several other universities and clinics in Europe and Africa.

"As a pioneering oncologist, Katarina has personally treated thousands of patients and mentored dozens of physicians and scientists in PDT methods around the world," says SPIE Fellow Bruce Tromberg, director of the Beckman Laser Institute and Medical Clinic at the University of California, Irvine (USA). Tromberg notes that since introducing PDT to Sweden in the 1980s, Svanberg has played a key role in advancing PDT worldwide, particularly in Brazil and China, and led the first prospective randomized Phase III trial of PDT more than 15 years ago.

"In addition to her contributions to this technical field, Katarina has played a significant role in expanding the impact and visibility of optics and photonics in the broader communities of biology and medicine," Tromberg says.

The Svanberg legacy of collaboration is being continued today through daughter Emilie. A specialist in anesthesiology and intensive care, Emilie Svanberg is currently involved in a project using diode laser spectroscopy to diagnose pulmonary disorders in newborns.

TRANSLATIONAL RESEARCH

Katarina Svanberg's contributions to the fields of tissue spectroscopy and photodynamic therapy have brought her recognition throughout the world, and her research collaborations cover five continents. Her groundbreaking work on laser-induced tissue fluorescence have made "optical biopsy" a reality for many types of cancer.

Now called "translational research," her longstanding approach to medical science and technology has been "a guiding light throughout her career and has served as a beacon to others," says SPIE Fellow and 2016 SPIE President Robert Lieberman of Lumoptix (USA).

"This deep commitment to the practical application of optics and photonics for the diagnosis and treatment of disease has helped save and improve the lives of hundreds of individuals," Lieberman says. "Furthermore, her activities in the developing world have changed countless other lives by bringing hope and guidance to many who would otherwise have no chance to contribute to science."

Svanberg, who served as SPIE president in 2011 and was a member of the SPIE Board of Directors from 2005 to 2007, sees receiving the SPIE Gold Medal as a crown on top of her career.

She is quick to point out, however, that she would not have reached this level without the collaborative help of Sune Svanberg, now an SPIE Fellow, Andersson-Engels, Niels Bendsoe, and several others, as her work has reached across disciplines.

"I may have been instrumental in connecting people from the medical side," Svanberg says, "but without the physicists, this would not have been possible.

Svanberg feels her involvement with SPIE, including serving as an editorial board member for the *Journal of Biomedical Optics*, is valuable not only to her work but also because through SPIE, she's had the chance to meet young scientists around the world. She believes it is important to encourage young people, especially girls, and help them develop self-confidence.

"I have tried to tell them some useful things from my own experience," Svanberg says. "If you feel you are not doing the thing you really want to do, do not be afraid to change your situation — even if it may mean a 180-degree turn-around."

She tells her students and other young scientists that life is about facing new challenges, not being afraid of the unknown, and being open to change. She uses her own life as an example. "Myself, I switched from a being a teacher of history and literature to become a medical doctor!" she says. ■

–Karen Thomas is an editor at SPIE.

Sustainable LASERS

The role of laser technologies in sustainable manufacturing processes

By **Rachel Berkowitz**

As society's already staggering demand for materials and goods continues to grow, the companies that produce these materials face increasing pressure to protect the global environment during manufacturing processes. Laser scientists and other photonics researchers certainly recognize the growing urgency to reduce costs and wastes while increasing efficiency and quality.

The quest for sustainable manufacturing processes has motivated many discussions on how laser-based technologies could help, especially in parts of Africa and other areas of the developing world that face unique infrastructure challenges and where sharing resources and knowledge is particularly important.

On the African continent, collaborations among international partners are opening new avenues for photonics research and industry to take hold, where they may help to reshape energy- and waste-intensive manufacturing practices in some of the continent's strongest economies.

The UN, which is working toward 17 goals for sustainable development by 2030, has defined sustainable manufacturing as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Science and technology have "a meaningful role to play in the development of sustainable manufacturing knowledge and technology," said Sechaba Tsubella, a chemical engineer and deputy director of advanced manufacturing technologies at South Africa's Department of Science and Technology.

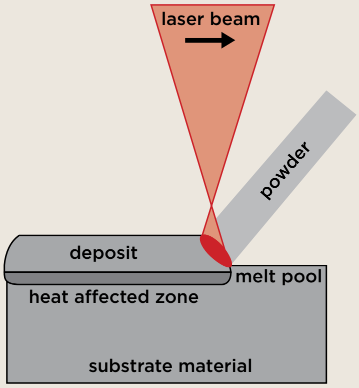
But his country must first "come to terms with a definition of what it means to be sustainable," he told attendees at a Sustainable Materials Processing and Manufacturing conference at the University of Johannesburg in January.

Representatives from academia, industry, and government there brought many examples of laser technologies that can help move South Africa and other developing countries toward defining and meeting international goals for sustainability. Scientists and engineers discussed projects such as manufacturing stronger steel, easily shaping titanium, and producing graphene in a single step.

Yet all face the reality that disparate knowledge, resources, and policies in different parts of the world slow progress toward realizing the potential of laser-assisted technologies to build locally sustainable processes.

STRONGER STEEL WITH LASERS

Even so, improving the durability of widely used materials provides an attainable sustainability goal in many developing regions, which is why laser scientists from across the globe came together in January to share resources and knowledge.



A schematic of laser surface alloying to make stronger steel.

Stainless steel is one of the most extensively used materials in structural projects from bridges to building frames, due to its excellent strength and corrosion resistance in dry environments. But it can suffer in gaseous and liquid environments.

To further enhance the utility of this widely available material, Jyotsna Dutta Majumdar, professor of metallurgical and materials engineering at the Indian Institute of Technology, investigates laser treatments that can increase the strength of stainless steel surfaces.

In laser composite surfacing, ceramic or metal particles are fed into a molten steel substrate. The resulting dispersed matrix on the surface improves strength and wear resistance and inhibits corrosion. The entire process not only reduces waste material and energy consumption while providing the requisite heating and cooling, but it eliminates radiation hazards, precisely processes complex shapes, and yields defect-free microstructures.

In a presentation at the conference in Johannesburg, Dutta Majumdar explained how different laser surfacing methods and additives improve the wear and corrosion resistance of steel. "The particle size and distribution can only be

Optics education spreads in Africa

Institutions in South Africa that are nurturing the next generation of optics and photonics innovators include the Council for Scientific and Industrial Research (CSIR), the University of the Witwatersrand, Johannesburg (South Africa), Stellenbosch University, and University of Johannesburg.

SPIE Student Chapters are active at CSIR, Wits, and Stellenbosch as well as in Tunisia, Egypt, and Cameroon.

A paper describing the activities of optics students in Africa was presented in 2014 at an SPIE conference on education and training in optics and photonics. See: **dx.doi.org/10.1117/12.2070775**.

A "training the trainer" program called Active Learning in Optics and Photonics (ALOP) has also helped raise awareness about the importance of optics education. ALOP workshops have reached more than 1000 teachers from about 50 developing countries in Africa, Asia, and Latin America since the program was created in 2004 under the auspices of the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

Members of the ALOP team received the 2011 SPIE Educator of the Year Award.

controlled by the proper combination of laser parameters," she said. Scan speed, laser power, metal particle distribution, and flow rate for dopant distribution all affect the resulting alloy's properties.

She melts the steel surface using a 1-2 kilowatt Nd:YAG laser, while simultaneously feeding a powder mixture of tungsten carbide, cobalt, and nickel chromide to the molten pool. The surface microhardness nearly doubles relative to the original material, but decreases as she increases the scan speed. In addition, the wear resistance improves due to increased surface hardness and reduced friction.

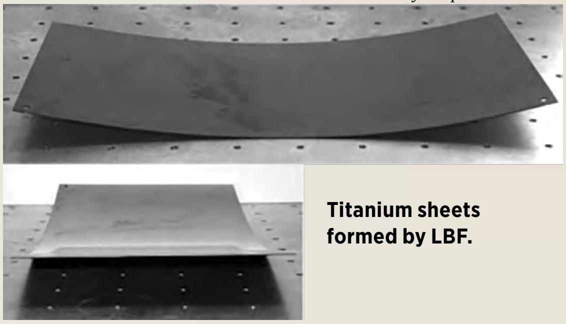
Illustrating the challenge of disparate resources in the developing world, Dutta Majumdar notes, "I don't have a laser in my group, but hopefully we will establish it soon. I am grateful to have free access to lasers in different research organizations in India and also institutes in Germany, UK, and South Africa. I do my laser work in collaboration with laser laboratories and do characterization and performance tests in my institute."

Her method is poised to help the many industries that rely on stainless steel. But making it available where needed still poses a challenge, as does understanding the precise combination of process parameters that lead to the desired product. "The manufacturing sectors need to join hands with materials scientists to understand the behavior of materials due to laser processing," she concludes.

SHAPING AND PROCESSING TITANIUM

Due to its strength, corrosion resistance, limited chemical reactivity, and biocompatibility, titanium metal has gained favor as a material of choice in the chemical, aerospace, marine, and biomedical industries. New work in South Africa explores ways to reduce the metal's high cost and simplify how it can be machined.

Courtesy Stephen Akinlabi



Titanium sheets formed by LBF.

Laser beam forming (LBF) offers a contact-free method for precisely shaping metals, by rapidly heating a localized area on the material's surface with a defocused laser beam. It consumes less energy than traditional heat treatment since the heating is localized, reduces processing time, and offers control over the heat source power and geometry. Yet, questions remain about how the method affects the properties of common titanium alloys.

Stephen Akinlabi of the University of Johannesburg's Department of Mechanical Engineering Science studies how the 'workhorse' alloy of the titanium industry, Ti6Al4V, responds to LBF. His goal is to control the processing parameters to achieve the desired properties for specific applications such as aircraft parts and medical implants.

Continued on page 10

SPIE, ICTP invest in sustainable optics

SPIE is a major supporter of an optics program at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Italy that supports optics researchers from developing countries.

The SPIE-ICTP Anchor Research in Optics Program has evolved into a well-equipped lab where optics associates at ICTP, postdocs, attendees of the annual Winter College on Optics, and scientists visiting from developing countries can conduct laser and microscopy research. Work has included projects in quantum cascade lasers, optical tweezers, and microscopy for applications in the physical and life sciences.

One of the goals is to make the research sustainable by showing visiting researchers how to set up similar labs in their home institutions with a modest investment.

Photonics Initiative in South Africa

SPIE Fellow Andrew Forbes of University of the Witwatersrand (South Africa) is hoping to gain support to relaunch the Photonics Initiative in South Africa (PISA) later this year.

The initiative, supported by the SA Department of Science and Technology, was established in 2008 to stimulate multidisciplinary research and human capital development, as well as to stimulate South Africa's economy via photonics.

PISA quickly led to the creation of industrial clusters in the country, but it never got off the ground.

Forbes, who helped organize a June workshop in South Africa on sustainable photonics for telecommunications, said he hopes he and others in the photonics field can raise awareness among the public and government officials about the importance of the field and come up with a new strategy to relaunch the initiative.

SUSTAINABLE LASERS

◀ *Continued from page 9*

Starting with a 4.4 kW Nd:YAG laser system, he simply varied the laser power to effectively monitor and control the alloy's properties. At lower power, the interwoven 'basket weave' microstructure of two titanium phases increased the metal's density. Higher power, however, increased the resulting microhardness.

This unique alternative system offers greater control than mechanical force-assisted forming. "Research into laser-related studies has grown tremendously in South Africa even though the actual equipment is not widely distributed across universities," Akinlabi says. "Academics and scientists have utilized the limited equipment to the utmost, and results are available to buttress this claim."

Courtesy Stephen Akinlabi

Academics and scientists have limited equipment for laser beam forming in South Africa but have used platforms like this at the University of Johannesburg to the utmost.

ONE-STEP NANOPHOTONICS FOR GRAPHENE

Lack of access to technologies and techniques limits the research that can happen 'at home' in many parts of the world. But countries with some of the strongest research infrastructure play an important role in spreading knowledge and products to the global market.

The traditional production method for graphene, for use in devices such as solar cells or touchscreen displays, involves growing each atoms-thin hexagonal lattice sheet separately at high temperatures and then transferring these to a metal or silicon base. This poses challenges, yet graphene-based technologies are increasingly valued because of their unique flexibility, strength, and conductive properties.

SPIE Fellow Xianfan Xu, professor of mechanical engineering and nanotechnology at Purdue University (USA), has developed an alternative method for growing graphene directly on the silicon substrate. Graphene films can form what's known as a Schottky junction with silicon, which is a metal-semiconductor interface with a built-in electric field for use in photovoltaic or photodetectors.

"Laser manufacturing for nanomaterials reduces bulk processing. It's like 3D printing for a specific piece, down to the p-n junctions [single crystal interfaces between semiconductor materials]," said Tien-Chen Jen of the University of Johannesburg, an organizer and chair of the conference.

In Xu's method, a laser provides the heat source for graphene growth. The beam scans the surface, melting patterns in an acrylic film on the substrate. After just minutes of melting, graphene appears, derived from the evaporated film as gaseous molecules decompose on the molten surface. As it cools, precipitated carbon atoms coalesce and nucleate to form the graphene film.

"The focused beam locally melts the silicon, so graphene growth only happens in the melted area," Xu explained in his conference presentation. The low-power laser (10 W), reduced substrate heating, and precise control over graphene position improves efficiency and reduces waste.

Xu applies a related technique to synthesize silicon nanowires, another promising material for next-generation electronic devices such as biosensors or solar cells. Here, reactive gases flow over the laser-heated silicon surface, where they decompose and write a chemical pattern in a single process. The method avoids metal catalysts and minimizes power to create a nanowire that is ready for use.

"The infrastructure in developing countries means that some of the nanomachining processes may not be possible there, nor is basic nanotech research. Our work is more relevant to producing products," Xu says. Nonetheless, this work plays an important and necessary role in helping developing countries build their capacity.

LASERS FOR THE FUTURE?

Tsubella, the deputy director of the South African Department of Science and Technology, observes that as a materials engineer, he started his career with the "constant desire to ensure that we develop materials that are cheaper, more reusable, less energy intensive, and more amiable to environmental vulnerabilities." But he's struggled to find the support to do so.

Laser-assisted materials processing is plagued by the high costs associated with equipment installation and a lack of skilled experts. Dutta Majumdar advocates for central laser facilities in "different corners of any country" so people from different areas can have access.

In South Africa, most laser systems are housed at the Council for Scientific and Industrial Research, where laser technology research began with the National Laser Centre. But the desire to pursue photonics research everywhere prevails.

"If there was adequate funding to support equipment for laser related studies, then there would be more activity on this subject and double the current research outcomes in the areas of lasers," Akinlabi predicts.

Leveraging this research to develop sustainable manufacturing, and pushing techniques to widespread use, requires a commitment to sharing resources and knowledge across and within international boundaries.

INDUSTRY PARTNERS WITH ACADEMIA

Wilson R. Nyemba, engineer and researcher with the Department of Mechanical Engineering Science at the University of Johannesburg, documented the challenges in procuring basic engineering equipment at higher education institutions in Sub-Saharan Africa.

Many laboratories have obsolete or poorly functioning equipment, obtained during the colonial era (1960-80) when institutions such as the University of Zimbabwe were managed as colleges of European universities. When these colleges became independent universities, their founders gradually returned home but did not leave sufficient plans for equipment replacement or repair. This resulted in obsolescence, underutilization, or disrepair, with no capacity to withstand setbacks.

Through his research, Nyemba has developed a strategic model that employs a holistic approach to drive "Smart Procurement Partnership" collaborations between universities and private sector industry. The aim is to build capacity in equipment maintenance and management during engineer training programs, while ultimately reducing foreign aid dependence.

He highlights the need to establish links with the private sector to improve institutions' access to modern equipment. Similarly, exposure to modern engineering practice and new technology is best achieved through industry-relevant research, he says.

Taking this approach, the University of Zimbabwe has benefitted from newly-acquired modern engineering equipment including computer numerically controlled (CNC) machining equipment, a live global system for mobile (GSM) telecommunications base station, and a mobile renewable energy lab called the solar trailer. "All this was courtesy of local Zimbabwean companies that have embraced the strategic model as a 'win-win' situation for all stakeholders," Nyemba says.

His exemplary efforts have fostered nurturing partnerships with industry, while developing long-term frameworks for training, capacity building, and sustainability within universities. ■

– Rachel Berkowitz is a US-based freelance science writer.

Optical sensor spots potential carcinogen in food

A molecular laser spectroscopy technique developed at VUB B-PHOT, the Photonics Team at Vrije Universiteit Brussels, could help spot early signs of elevated acrylamide levels in potatoes, tackling a current concern in food safety.

Acrylamide is formed when bread, potatoes, and other foods rich in starch are cooked for too long or at very high temperatures. The International Agency for Research on Cancer (IARC) classifies acrylamide as a "probable human carcinogen" based on data showing it can increase the risk of some types of cancer in lab animals. The chemical is the subject of a campaign by the UK Food Standards Agency to raise awareness of the dangers of overcooked toast and other staples.

SPIE CEO Eugene Arthurs (left) and Lien Smeesters at the Photonics21 meeting earlier this year.

The nondestructive scanning technique developed by SPIE member Lien Smeesters, a post-doctoral researcher at B-PHOT, earned the 2017 Photonics21 Student Innovation Award, which is sponsored by SPIE and Hamamatsu. Smeesters' innovation scans peeled potatoes before they move into the food manufacturing process, weeding out those that may cause high levels of acrylamide when subsequently cooked.

In collaboration with Tomra Sorting Solutions, her technique will be incorporated into a sorting operation for French fries, identifying the items to be removed while they are in free fall, and doing so without the need for added chemicals or dyes.

An infrared laser scans the falling chip from both the front and rear sides and detects the characteristic molecular fingerprint of elevated levels of acrylamide precursors in the light that emerges from the potato after internal scattering. Having been identified in mid-air, a directed jet of air removes the sub-standard item from the food stream.

"Not all potatoes result in excessive acrylamide formation during frying," Smeesters says. "We have sought to spot the undesirable potatoes when they are in their raw, peeled stage. After scanning with laser beams, the good potatoes will emit a different light signal than the unsuited ones leading to an unambiguous detection."

The potatoes with acrylamide precursors do not have to be thrown away, however. Smeesters noted that they may still be suitable for low-temperature processes, such as in making mashed potatoes or soup.

HOME TESTING IN THE KITCHEN?

Previous research by B-PHOT in this area, including Smeesters' doctoral thesis, demonstrated the potential value of molecular spectroscopy in identifying food contaminants such as mycotoxins, poisons produced by toxic fungi. A case study investigated the use of fluorescence techniques, in particular one- and two-photon-induced fluorescence spectroscopy, as a means to spot aflatoxin in individual kernels of maize. The technique accounts for the natural fluorescence of proteins in maize as well as the variations in density and texture of the material under analysis.

The new contactless operation for potatoes could ultimately lead to an operation suitable for domestic use, making it available to users in the kitchen.

"Although we are a long way off, the miniaturization of the technology would enable a compact potato quality test tool in your home," Smeesters says. "A hand-held device indicating whether a potato would be unsuited for frying could reduce our exposure to acrylamide."

Smeesters, a member of SPIE Fellow Hugo Thienpont's research group, was an active member of the SPIE VUB Student Chapter, the largest SPIE Student Chapter in Western Europe.

Smeesters said the Photonics21 award shows the importance of applied scientific research and the ability of optical technologies to solve real-life problems.

"I want to thank B-PHOT and Tomra Sorting for the opportunity to work on this exciting research topic," she said, "and for enabling the integration of the technologies I developed into the state-of-the-art optical sorting machines."■

More on photonics and food safety

A recorded presentation from the 2017 SPIE Defense + Commercial Sensing event on optical tools for food quality and safety is freely available on **SPIE.org**.

Richard Crocombe, cochair of the next-generation spectroscopic technologies conference, discussed recent advances in optical tools to meet food safety challenges such as chemical contamination and food fraud.

Crocombe, a consultant in handheld and portable spectroscopy, delivered his talk at a photonics industry session and covered the way portable analytical instruments can detect melamine in powdered milk, horsemeat sold as ground beef, and "chicken" eggs that have not come from chickens.

For more information: **spie.org/crocombe-video**

Solar-powered scope saves sight and sound

An estimated 285 million people around the world are visually impaired, and 360 million are hearing impaired. While the majority of these cases are considered preventable or treatable if diagnosed promptly, getting that diagnoses can be difficult and expensive for many. A low-cost, solar-powered ophthalmoscope called Arclight aims to solve this issue.

Developed by a team led by University of St Andrews (UK), the pocket-sized Arclight can also be used as an otoscope to look for any problems in the ear that may lead to hearing loss. Since the majority of vision and hearing impairment cases are found in countries with the least access to medical care, Arclight was designed specifically to be an easy-to-use tool for screening programs in low-income countries.

Doctors in poorer countries rarely have ophthalmoscopes, which can be complex, heavy, and expensive. Available tools are often hand-me-downs that don't work properly because they need hard-to-find or costly parts, such as bulbs and batteries.

"Arclight is the result of years of hard work by a small team of enthusiasts," says Andrew Blaikie, a clinical academic at St Andrews, who also works as an eye surgeon at Queen Margaret Hospital. "These efforts have brought simple, frugal yet highly effective tools to health care workers who would otherwise be unable to make the early diagnoses needed to prevent needless blindness."

COMPACT, POWERFUL DESIGN

Uncorrected refractive errors are the main cause of visual impairment, and cataracts are the leading cause of blindness. Arclight lets an examiner see the front and back of the eye, revealing any major blinding conditions such as trachoma, cataracts, glaucoma, or diabetes, and make quick, on-the-spot diagnostic decisions. The adjustable lens slider has three different lenses, allowing for a rough correction of a patient's refractive error.

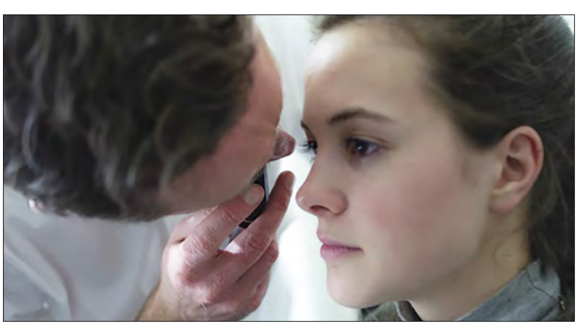
The device uses three LED light sources – two white LEDs to render eye and ear tissues accurately and evenly and a unique violet/blue LED to reveal subtle yet vital corneal defects. Being low in infrared and ultraviolet, the Arclight enables a comfortable and safe examination for the patient.

Weighing less than 1 oz (18 grams), the Arclight can be carried in a shirt pocket or worn around the neck. The compact design features a small, direct ophthalmoscope at one end with an illuminating magnifying loupe and a detachable otoscope at the other end. The otoscope specula are easily attached by push-fitting over the loupe. The integrated solar panel or a USB port can power the built-in, rechargeable battery. Each unit includes a small color vision test, a near visual acuity chart, a ruler, and a gauge for measuring pupil size.

MEDICAL SCHOOL TOOL

In collaboration with the Fred Hollows Foundation (Australia) and the International Agency for Prevention of Blindness (UK), thousands of Arclights have been distributed to Malawi, Ethiopia, Kenya, Fiji, and other countries.

The device has also proven to be an ideal tool for medical students and doctors in the UK. David Harrison, director of research in the Medical School at St Andrews, says the Arclight shows how universities, health services, industry, and partners outside the UK can work together to meet global needs in a realistic and effective manner.



Courtesy of Arclight Medical

Andrew Blaikie using Arclight on a student.

"We will be providing this versatile and clever instrument to our medical students as they enter clinical training," Harrison says.

Blaikie notes that the team, which includes colleagues from the University of Leicester and University College London, plan to add internal memory to the device, which would be loaded with teaching material and allow image capture by mobile phones.

"At the same time," he adds, "we are developing several other potentially disruptive low-cost diagnostic tools aimed at serving the needs of health care workers in poorer countries." ■

CONTRIBUTE to our series

Optical and photonics technologies can ensure the safety of food, bring inexpensive and efficient health care to rural and developing areas, enable instant communications, and otherwise bring tangible social, environmental, health, and economic gains to humanity.

Do you have a story to contribute about the role of light-based technologies in bettering the human condition?

Write to us at **spieprofessional@spie.org**.

Read more articles and blog posts celebrating the many ways that optics and photonics are applied in creating a better world at **PhotonicsForaBetterWorld.org**.

Powerful lasers celebrated at SPIE meeting in Prague

The European X-ray Free Electron Laser (XFEL) in Germany was the subject of much celebration during and shortly after SPIE Optics + Optoelectronics this spring.

European XFEL Managing Director Robert Feidenhans'l, one of five plenary speakers at the SPIE conference in Prague in April, announced on 4 May that the biggest X-ray laser in the world had generated its first X-ray laser light.

"The facility, to which many countries around the world contributed know-how and components, has passed its first big test with flying colors," Feidenhans'l said, adding that his colleagues and international partners "accomplished outstanding work."

The 3.4 km long facility, most of which is located in underground tunnels near Hamburg, has the most powerful linear accelerator in the world and marks the beginning of a new era of research in Europe. The German research center DESY, the largest shareholder of the European XFEL, put the accelerator into operation at the end of April.

It has an X-ray light with a wavelength of 0.8 nm — about 500 times shorter than that of visible light. At its first lasing, the laser had a repetition rate of one pulse per second, which will later increase to 27,000 per second.

Feidenhans'l reported at SPIE Optics + Optoelectronics that once the facility is fully operational, the system will provide a peak brilliance billions of times higher than that of conventional X-ray sources, with photon energies in the range of 0.3-24keV and pulse widths on the order of 10-100fs.

The European XFEL will enable applications development in the areas of structural dynamics, nanoscale imaging, and non-linear X-ray science, he said.

"We can now begin to direct the X-ray flashes with special mirrors through the last tunnel section into the experiment hall, and then step by step start the commissioning of the experiment stations," he said. "I very much look forward to the start of international user operation, which is planned for September."

Since the achievable laser light wavelength corresponds to the size of an atom, the X-rays can be used to make pictures and films of the nanocosmos at atomic resolution, such as of biomolecules, from which better understandings of the basis of illnesses or the development of new therapies could be developed. Other opportunities include research into chemical processes and catalytic techniques, with the goal of improving their efficiency or making them more environmentally friendly.

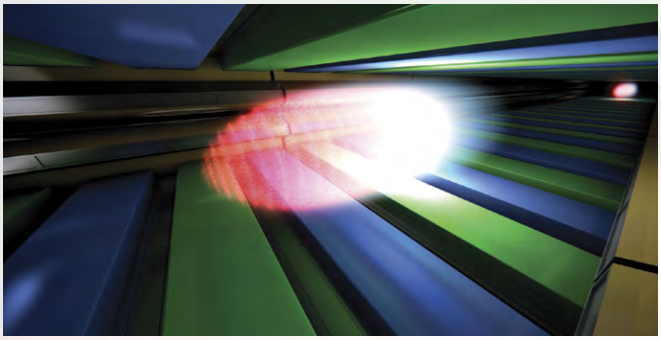
With more than 27,000 light flashes per second instead of the previous maximum of 120 per second, an extremely high luminosity, and the parallel operation of several experiment stations, scientists will be able to investigate more limited samples and perform their experiments more quickly. The new facility means an increase in the amount of "beamtime" available to scientists, as the capacity at the other four X-ray lasers worldwide has been eclipsed by demand, and facilities have been overbooked.

SOURCES AND OTHER XFEL ADVANCES

Several conferences at SPIE Optics + Optoelectronics were devoted to XFEL applications, sources, damage, and instrumentation.

In a conference on sources and instrumentation for XFELs later in the week, Sebastien Berujon of the European Synchrotron Radiation Facility (France) discussed the development of a hard X-ray wavefront sensor for use in the European XFEL beamline.

Criteria for the sensor include beam wavefront characterization for each pulse in a non-invasive fashion.



European XFEL / Marc Hermann

To generate the extremely short and intense X-ray laser flashes, bunches of high-energy electrons are directed through special arrangements of magnets (the green-blue structure).

A challenging aspect of the design results from the fact that within the 10Hz-repetition-rate pulse train lies individual pulses within each burst at a 4.5MHz repetition rate. Characterizing each of those pulses requires fast optical components.

Several approaches to at-wavelength metrology exist, and the team adopted a new approach leveraging near-field speckle properties, Berujon said. The resulting setup relies on two streaming cameras and low-absorbing, fast-decay-time scintillators to image the beam with minimal disturbance.

Particularly impressive was the implementation of an X-ray speckle scanning mode capable of reaching single nano-radian accuracy.

SCALABLE TECHNOLOGIES

Plenary talks during the week encompassed the range of technology and science showcased at SPIE Optics and Optoelectronics.

Jonathan Zuegel of the Laboratory for Laser Energetics at University of Rochester (USA) described work being done to produce scalable technologies to upgrade the OMEGA EP laser system to enable pumping of the EP OPAL optical parametric amplifier line. The end goal is an output power density in excess of 1023W/cm^2 with pulse widths of approximately 20fs.

Primary challenges included development of appropriately sized broadband gratings with suitable damage threshold and ultrabroadband wavefront control and focusing to achieve the desired intensities.

Constantin Haefner of the US National Ignition Facility and the Photon Science Directorate at Lawrence Livermore National Lab (LLNL) discussed the development of high-repetition-rate petawatt lasers and in particular the High-repetition-rate Advanced Petawatt Laser System (HAPLS).

LLNL developed HAPLS in conjunction with the Extreme Light Infrastructure (ELI) beamlines team with the goal of installing the system at ELI-Beamlines in the Czech Republic in 2017. It represents a significant step forward in taking high-power systems towards higher repetition rates in anticipation of eventually moving towards commercial applications.

The system produces 1PW at 10Hz as demonstrated during its commissioning run in late 2016. Measuring 17m x 4.6m, the tabletop system takes advantage of eight core technologies including gas cooling for the amplifiers and high-average-power gratings to meet specifications.

RANGE OF PHOTONICS TOOLS

SPIE Fellow Kishan Dholakia of the University of St Andrews (UK) discussed utilizing the forces resulting from the scattering of light from and refraction of light through micron-sized objects to manipulate such objects.

Optical manipulation of materials not only encompasses interesting physics but has found a variety of applications, particularly in the life sciences.

Dholakia described how the slow-light effect in photonic crystal waveguides enhances the speed with which one can move objects. He discussed not only translational motion of objects but also how to utilize circularly polarized light to effect rotation and the benefits in Q-factor seen when operating in a vacuum, which has implications in sensing applications.

Although this method has been around for over 40 years, Dholakia's presentation showed that future applications in sensing and in conducting tests at the classical-quantum interface as well as other areas will keep it relevant and interesting in the future.

SPIE Fellow Demetri Psaltis of the Ecole Polytechnique Fédérale de Lausanne (Switzerland) gave a plenary talk on imaging with multimode fibers, reporting on promising results that bode well for the future of multimodal fibers in endoscopic applications and in other imaging applications.

The research is motivated by the need for improvements in endoscopes, which currently rely on fiber bundles of millimeter sizes in diameter. Because bending the fibers can be an issue, the system historically has been used as a rigid probe.

Multimode fibers provide a path to reduce these diameters into the hundreds of microns range, albeit with larger core diameters than that found in single-mode fibers. This results in a deterministic scattering and modal dispersion that can be analyzed to produce high-quality images, something that was demonstrated in fluorescent imaging of neuronal cells. The large number of temporal and spatial degrees of freedom available with multimodal fibers enables high-resolution imaging in a compact operation.

Psaltis described recent work on speckle scattering microscopy, which eliminates the need for calibration and demonstrates no bending sensitivity.

Some of the most advanced laser technologies were covered in a workshop on intense, high-average-power lasers and a conference on high-power, high-energy, and high-intensity laser technology, and the week wrapped up with a tour to the HiLASE Laser Centre and ELI Beamlines facility.

Recordings of some of the presentations can be found in the SPIE Digital Library along with the proceedings papers.

Read the event news from SPIE Optics + Optoelectronics and other SPIE conferences at **spie.org/eo017news**. ■

RECOMMENDED READING

New model of Schottky-barrier solar cell shows improved power-conversion efficiency

By **Zakya Kafafi**

Scientists working to develop affordable and efficient solar panels have developed a new design that early simulations predict will increase power-conversion efficiency more than 25%.

Tom Anderson and Tom Mackay of the University of Edinburgh and Akhlesh Lakhtakia of Pennsylvania State University described their model in "Enhanced efficiency of Schottky-barrier solar cell with periodically nonhomogeneous indium gallium nitride layer," published in the *Journal of Photonics for Energy* earlier this year.

Indium gallium nitride (InGaN) possesses optical and electrical properties superior to those exhibited by amorphous silicon. The Schottky-barrier junction of lightly doped InGaN and a suitable metal can easily separate electrons and holes.

In their quest for affordable solar cells, the authors designed a Schottky-barrier solar cell wherein the proportions of indium and gallium were varied periodically in the direction perpendicular to a periodically corrugated metallic back reflector.

Their first-principles optoelectronic simulations predicted a relative increase of 26.8% in device power-conversion efficiency attributed to enhanced electron-hole-pair generation. This was the result of improved optical coupling to guided-wave modes arising from the periodic nonhomogeneous film of InGaN, without proportional enhancement of electron-hole recombination.

The open access article is in the SPIE Digital Library at: **dx.doi.org/10.1117/1.JPE.7.014502**. ■

–SPIE Fellow Zakya Kafafi is founding editor and editor-in-chief of the Journal of Photonics for Energy.

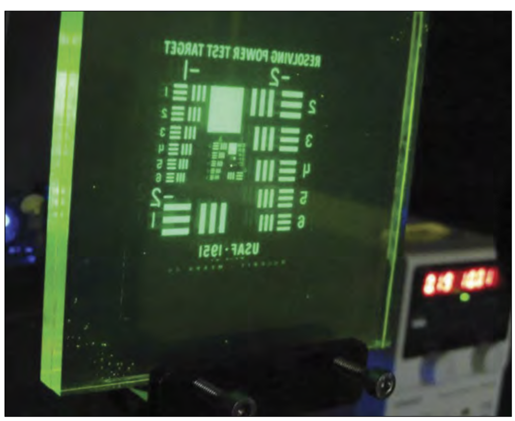
RECOMMENDED READING

LSCs for displays and energy harvesting

Researchers at Ritsumeikan University (Japan) have successfully conducted a proof-of-concept experiment that employs a luminescent solar concentrator (LSC) to harvest energy from ambient light as well as display high-resolution images.

The researchers describe the development, processes, and applications for replacing the phosphor screen in a laser phosphor display (LPD) with an LSC in a recent article published in the *Journal of Photonics for Energy*.

In "Energy-harvesting laser phosphor display and its design considerations," SPIE member Ichiro Fujieda and his colleagues at Ritsumeikan University (Japan) fabricated a 95 × 95 × 10 mm screen by sandwiching a thin layer of coumarin 6 with two transparent plates. These plates guided the photoluminescent (PL) photons emitted in both directions toward their edge surfaces.



A resolution test chart displayed on a phosphor screen, from *Journal of Photonics for Energy*.

After removing the light source in a commercial grade projector using digital micromirror device technology and feeding a blue laser beam into its optics, the screen generated green images.

Attaching a photodiode with a 10 × 10 mm sensitive area on the bottom edge of the screen to record the power of the PL photons indicated that a fully covered version would harvest up to 71% of the incoming optical power. However, a ghost image was noticeable when displaying a high-contrast still image.

Fujieda and coauthors Shunsuke Itaya, Masamichi Ohta, Yuuki Hirai, and Takamasa Kohmoto addressed two important design considerations.

First, tiling small modules and extracting the PL photons in each module reduces the thickness of a large-area system and alleviates the effect of self-absorption. For seamless tiling, attaching an output coupler to the wave guiding plate and mounting solar cells provides an optimal solution.

Second, the origin of the ghost image is the PL photons reflecting at the interface between the rear plate and the outside environment. By reducing the thickness of the rear plate on the LPD, they were able to eliminate this optical cross talk between pixels.

Loucas Tsakalakos, associate editor for the *Journal of Photonics for Energy*, called the study "a unique and novel application of a luminescent solar concentrator for display applications."

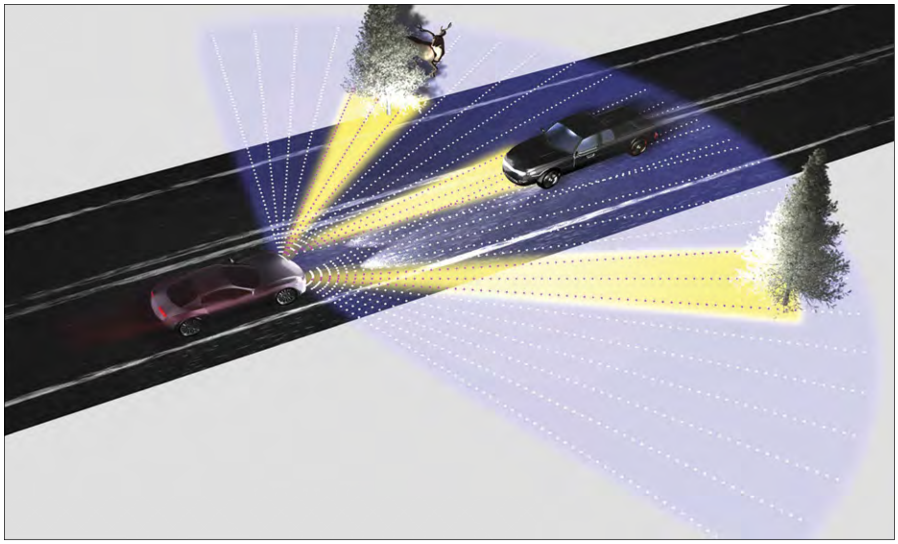
He said the work shows practical operation of such a device, "describes the basic operational principle and expected energy-harvesting capability of such a system, and describes ways of improving the design in future work."

Source: **dx.doi.org/10.1117/1.JPE.7.028001.** ■

RECOMMENDED READING

Lidar to get you there safely

By **Michael T. Eismann**



Lidar bounces light beams off objects rather than using radio waves in this autonomous automobile vision system.

As our roads and airways become ever more congested, optical engineers are investigating ways to make transportation more efficient and safe. For example, sensors provide enhanced situational awareness.

One sensing approach currently at the exploratory stage is the use of light detection and ranging, or lidar, which uses laser light for range measurement, velocity sensing, and three-dimensional imaging to enhance operator awareness, whether the operator is a human or an automated control system.

The March 2017 issue of *Optical Engineering* includes a special section that provides an excellent synopsis of the state of the art in laser radar, a term often used synonymously with lidar.

Two noteworthy papers delve into the topic of transportation safety.

The first focuses on the use of lidar for monitoring wind dynamics around airports to warn pilots and air traffic control of unsafe conditions. The second explores sensor lidar design issues for autonomous automobile navigation.

In their paper, "Long range wind monitoring in real time with optimized lidar," scientists from ONERA, the French Aerospace Laboratory, describe their efforts to develop a coherent Doppler

Continued on page 25 ▶

Plenary speakers at SPIE DCS challenge scientists to develop new technologies for space and security

Hundreds of photonics experts became one giant brainstorming team at SPIE Defense + Commercial Sensing (DCS) in April as two speakers issued big challenges in one of the most dramatic plenary presentations in the conference's history.

First Thomas Burns, director of the Strategic Technology Office at the US Defense Advanced Research Projects Agency (DARPA), asked for help with innovations in sensors and communications to keep the US military ahead of its adversaries on fast-evolving strategies.

Then Parker Abercrombie, lead scientist at the Immersive Visualization Project in NASA's Jet Propulsion Laboratory (JPL), led the audience on a virtual tour of Mars for an on-screen workout much like the virtual-reality space exploration sessions he runs at JPL. He invited the experts to think how such an opportunity with augmented reality (AR), virtual reality (VR), and holography might enhance any such training.

Conventional space training just doesn't work, Abercrombie said. "Looking at pictures, we can't understand what an area of Mars is like," he said. Showing images taken by the Curiosity rover, he pointed out that a curve on Mars shows up as a straight line and a pebble can look like a boulder. However, by letting trainees "enter" a 3D landscape that combined images from several sources, their skills soared.

Abercrombie showed data to document how his immersive visualization system works two or three times better than the official "mission tool" in getting trainees to estimate distances and locations for maps.

Then the crowd went inside the International Space Station, before joining Abercrombie for a virtual jog up a mountain on Mars — where the geoscientists he trains do likewise.

NEW TECHNOLOGY CULTURE NEEDED

Earlier in the plenary session, Burns had reminded his audience at the Anaheim (CA) Convention Center, that DARPA is the American military arm that invents new things "that fly and swim and crawl and go boom."

After the Soviets got the jump on America by launching Sputnik in the 1950s, US President Dwight Eisenhower launched DARPA to prevent such surprises. Burns said DARPA survives by bringing in the smartest people from industry, universities, and businesses.

Several times he asked attendees to send in ideas from their own areas of photonics expertise to help build a new culture at DARPA, a team that is building, in Burns own words, "a system of systems that work together to achieve a new type of weapon: that weapon is complexity."

Over the years, DARPA has recorded many successes in battlefield intelligence, surveillance and reconnaissance (ISR), stealth devices, and precision strike capabilities. But today, such innovations take too long to devise, especially when other countries can match US innovation with newer and better weapons.

Burns, a pioneer of technologies that can extract information from massive quantities of multisensor data, called his plan "a composable strategy," in which all parts and agency divisions are constantly able to fit existing elements together in new ways. "It's the third wave of systems," he said.

"I am advocating a framework that creates a system of systems that can be tailored for different kinds of conflict, that doesn't take forever to get things out the door. It will combine manned with unmanned systems, so our adversaries cannot keep up with us in time or in space."

INTERCONNECTED APPROACH

To illustrate, Burns showed a video of a pair of military planes. The first plane was an unmanned information collector that can relay data to the second, a flying "resource truck" or repository of weapons. The second plane can release a cloud of small missiles, so many that an enemy would waste a lot of firepower without stopping them all, letting some explode their targets.

"We can impose complexity on our adversaries," Burns said, adding that further details about his new interconnected approach will be disclosed in the next six months or so.

A new challenge, Burns added, is finding ways to combat military threats in cities, without much collateral damage. "That's a big concern,"

he told his audience. Lower-level conflict operations will also take place in urban environments, he said. "That's the way the world is moving."

He asked attendees for help developing technologies to defend against modern threats. "If a small, non-state group were to become burrowed deep into Jakarta and decided it would take down New York City or hold it hostage, we need to be able to take them out or neutralize that capability," he said. "The key technology could be one we need you to help us develop today."

Burns concluded, "I hope this strategic context will whet your appetite."

Nearly 4,600 participants attended SPIE DCS 2017, in the long-running event's first showing on the West Coast.

RISING RESEARCHERS HONORED

Ten distinguished early-career scientists selected as the inaugural group of SPIE Rising Researchers were honored during welcome remarks before the plenary session.

Honorees were John Hennessy and Adrian Tang, NASA JPL, along with SPIE members Fei Tian, Stevens Institute of Technology (USA); Junsuk Rho, Pohang University of Science and Technology (Republic of Korea); Shuo Pang, University of Central Florida (USA); Daniela Moody, Descartes Labs (USA); Yongmin Liu, Northeastern University (USA); Daniel LeMaster, US Air Force Research Lab; Matt Graham, Oregon State University (USA); and Nathan Cahill, Rochester Institute of Technology (USA).

SPIE President Glenn Boreman, left, with Rising Researchers at DCS.

Anaheim is part of a three-city rotation for SPIE DCS in the USA. The event moves to Orlando, FL, 15-19 April 2018, and Baltimore, MD, in April 2019.

The Society's Europe meeting, SPIE Security + Defence, will be held 11-14 September in Warsaw, Poland. See page 36. ■

SPIE DCS returns to Orlando in 2018

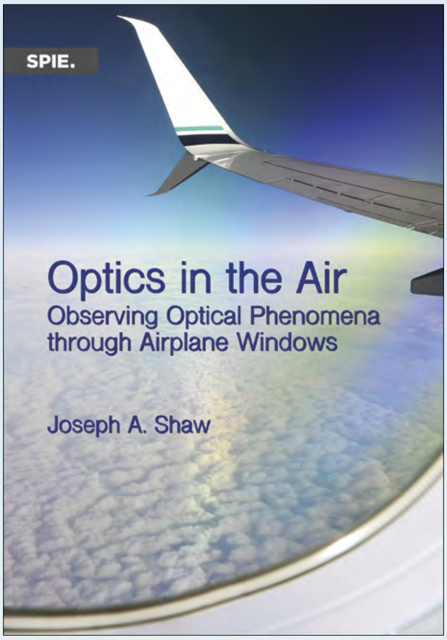
Abstracts for SPIE Defense + Commercial Sensing 2018 are due 9 October.

The 2018 event will be held 15-19 April in Orlando, FL (USA).

For more information: **spie.org/DCS**.

PICTURE THIS

Optics in the Air

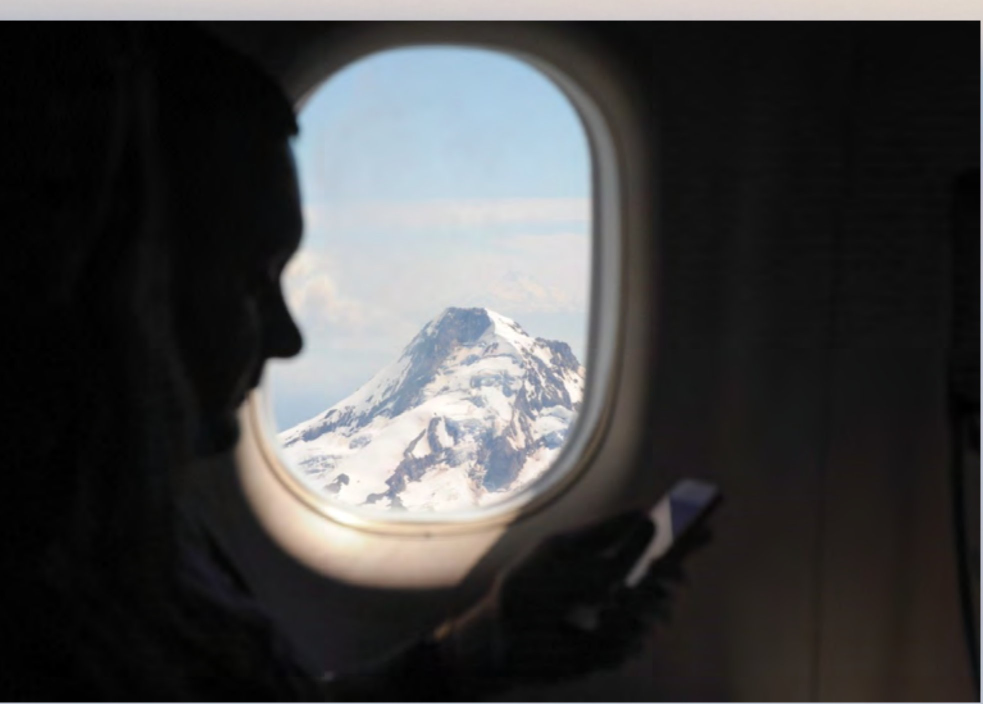


Rainbow, corona, glory, sundog, or halo? Not all scattering from water droplets or ice crystals are rainbows, but SPIE Fellow Joseph Shaw finds all types of sunlight transformed into previously hidden colors "visually irresistible."

Observing and photographing optical phenomena in the atmosphere has been Shaw's lifelong passion. Now, 30 years after receiving his BS in electrical engineering under the auroras of Alaska and 21 years after earning his PhD in optical sciences in Arizona, where he vowed to learn everything possible about natural optical phenomena, Shaw's photographic collection and explanation of "optical beauty" has been published in a new book.

Optics in the Air: Observing Optical Phenomena through Airplane Windows is Shaw's illustrated introduction to how to see the rich array of colors and optical effects that occur in nature. Although mainly about observation and photography from aloft, readers who have their "heads in the clouds" and their feet firmly planted on the ground will find many of the photography tips and descriptions of optical phenomena useful and accessible.

Simple line diagrams and a glossary of optical terms supplement more than 200 photographs depicting everyday sky and sunset colors, auroras, noctilucent clouds, and shadows. In addition, Shaw says he hopes to inspire others with "a whole world of too-often-ignored occurrences such as sun glitter patterns on bodies of water, colorful ringed glories and coronas, rainbow-like patterns that cling to the clouds below a high-flying airplane, and ice halos that spring up as an airplane passes through high-altitude ice clouds."



Choosing a window seat is important but not always necessary to frame your photo.

WINDOWS ON A PLANE

The book is divided into chapters on different types of optical phenomena and begins with an introduction to photography and observation techniques aboard an airplane. Shaw explains how to create – or avoid — unusual effects through airplane windows, which are often scratched and do not have high-quality optical surfaces.

"Most airplane windows have two thick panes of stretched acrylic, separated by an air gap and mounted in a pressure seal," he writes. "The thickest outer pane is designed to withstand the large stress of cabin pressurization and is sometimes curved to match the external aircraft body. The middle pane has one or more breather holes to allow cabin air to reach the inner surface of the outer pane.

"Without this hole, moist air reaching the inner surface of the outer pane would condense on the window because the outside air at flight altitude is extremely cold (typically –40 to –60°C)." Nevertheless, Shaw says passengers can sometimes see window condensation or ice during a descent into more humid air.

Since the stretched acrylic material of the airplane window is birefringent, it bends and transmits light differently for light waves oscillating in different directions, i.e., light of different polarization states, Shaw explains. And it does this differently for different colors.

"In fact, a well-known optical method of testing for material stress involves placing the material between two crossed polarizers, i.e., polarization filters with orthogonal

Photographing the famed Eiffel Tower through a birefringent transit-car window with a polarizing filter over the camera lens creates a surreal effect.

transmission axes, and observing the resulting pattern of pastel colors," Shaw writes.

Shaw advises photographers to remove their polarizing filter on the camera lens when taking a picture through the airplane window unless your intention is to produce dramatic colored patterns with the "stress birefringence" in the window.

The book contains several examples of skylight polarization, including a surreal image of the Eiffel Tower taken with a polarizing lens filter through a birefringent transit-car window in Paris.

A chapter on shadows is illustrated with photographs of eclipses as well as shadows from clouds, mountains, and airplane contrails, some with a bonus glory.

Shadows might seem like trivial optical phenomena, he writes in chapter 6, "but they actually contain a variety of brightness and color if you observe carefully."

–Joseph Shaw is the director of the Optical Technology Center at Montana State University (USA) and a professor in the university's College of Engineering. He develops optical remote-sensing instruments for applications ranging from airborne laser mapping of fish to polarimetric imaging of the atmosphere. He is the recipient of a US Presidential Early Career Award for Scientists and Engineers, the Vaisala Award from the World Meteorological Organization, and an Award for Excellence from the University Economic Development Association.

His book is available through SPIE Press at **spie.org/PM274**. ■

PHOTO CONTEST AT SPIE OPTICS + PHOTONICS

SPIE Press author Joseph Shaw is a cochair of the Light in Nature and Polarization Science and Remote Sensing conferences at SPIE Optics + Photonics in August.

A polarization photo contest is being held in conjunction with the latter conference, and prizes will be awarded at a 3:10 pm ceremony 8 August.

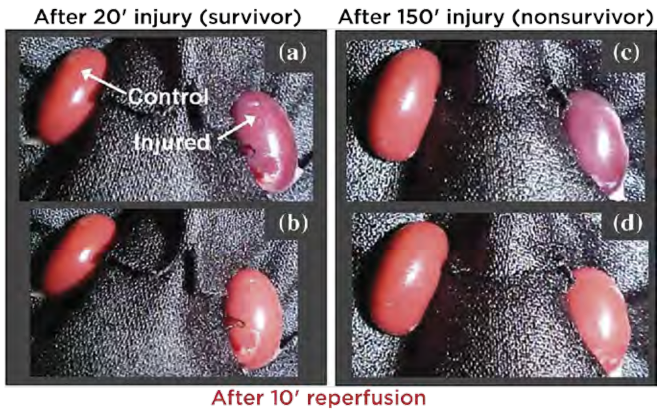
Deadline for submissions is 4 August.

For more information, see:
spie.org/PolarizationPhotoContest.

Optical spectroscopy technique could improve assessment of kidney function in real time

A new optical technique developed by American researchers promises to improve accuracy and reduce costs of real-time assessment of kidney function.

An open-access article published in May in the *Journal of Biomedical Optics* explores the use of multimodal autofluorescence and light scattering to evaluate functional changes in the kidneys after ischemic injury. Conditions such as accumulated arterial plaque or blood clots restrict the flow of oxygen and glucose to organs, and prolonged periods of such ischemia can compromise function.



Normal visual observation of injured and non-injured kidneys of two rats under anesthesia (resting on a black cloth) cannot predict which rats would survive (a and b on left) and which would die (c and d on right). Authors of a paper in the *Journal of Biomedical Optics* say observations with multimodal autofluorescence and light scattering techniques could help predict kidney function after injury.

In "Predictive assessment of kidney functional recovery following ischemic injury using optical spectroscopy," the authors report on their evaluation of various optical signatures to predict kidney viability and suggest a noncontact approach to provide clinically useful information in real time.

While other work in this area uses expensive multiphoton and laser-based techniques, the authors lowered expenses by switching to camera-based imaging.

No real-time tool is in current use to measure the degree of ischemic injury incurred in tissue or to predict the return of its function. Doctors unable to decisively determine tissue functional status run the risk of increasing patient morbidity and mortality if they transplant dysfunctional tissue. In addition, they may discard much-needed functional kidney tissue because they are unable to assess its viability.

The study was authored by Rajesh Raman, a scientist at Lawrence Livermore National Lab, and coauthors Christopher Pivetti, a research lab supervisor at the University of California, Davis Medical Center; Rajendra Ramsamooj, a transplant expert from California Northstate University College of Medicine; Christoph Troppmann, a transplant surgeon at UC Davis; and Stavros Demos, a senior scientist at the Laboratory for Laser Energetics at University of Rochester.

The authors acquired autofluorescence images of rat kidneys in vivo under 355, 325, and 266 nm illumination. They collected light-scattering images at the excitation wavelengths while using a relatively narrow band light centered at 500 nm.

The images were simultaneously recorded using a multimodal optical imaging system. Researchers then analyzed the recorded signals to obtain time constants, which were correlated to kidney dysfunction as determined by a subsequent survival study and histopathological analysis.

Analysis of the light-scattering and autofluorescence images suggests that variations in tissue microstructure, fluorophore emission, and blood absorption spectral characteristics, combined with vascular response, contribute to the behavior of the recorded signals. These are used to obtain tissue function information and enable the ability to predict post-transplant kidney function.

This information can also be applied to the prediction of kidney failure when visual observation cannot, almost immediately following an injury.

Reviewers of the article suggested other promising applications for future development and envisioned the approach being used as a screening tool for assessing kidney viability prior to transplant. In particular, they said, these cost-effective screening methods could benefit healthcare in developing countries.

Multimodal imaging also has provided insights into other physiological events that may occur during ischemia and reperfusion.

"This work's exceptional value lies in the realization of a workable practical system that has excellent potential to be adopted in field situations," said SPIE Fellow Andreas Mandelis of University of Toronto, a journal associate editor.

Source: **dx.doi.org/10.1117/1.JBO.22.5.056001** ■

Special journal section on wearable vision systems

Wearable visualization systems are at the forefront of consumer electronics product development, and social media companies are investing heavily in enabling compelling experiences through augmented and virtual reality (AR/VR).

A special section on Wearable Vision Systems: Head/Helmet-Mounted Displays in the May issue of *Optical Engineering* aims to help boost consumer-driven advances in applications in automotive, industrial, and military vision systems.

The significant commercial investment in these systems for personal communications and entertainment is driving rapid advances in miniature optoelectronics components and product design, note special section guest editors Darrel Hopper and Peter Marasco of the US Air Force Research Lab, James Melzer of

Thales Visionix, and Michael Browne of SA Photonics.

The goal of the special section is to facilitate these advancements. Papers in the section describe a variety of approaches and technologies.

In "Daylight luminance requirements for full-color, see-through, helmet-mounted display systems," Thomas Harding and Clarence Rash of the US Army Aeromedical Research Lab and Oak Ridge Institute for Science and Education describe two lines of investigation in luminance requirements to address visual perception issues of concern when color is implemented in eyes-out, see-through helmet-mounted displays.

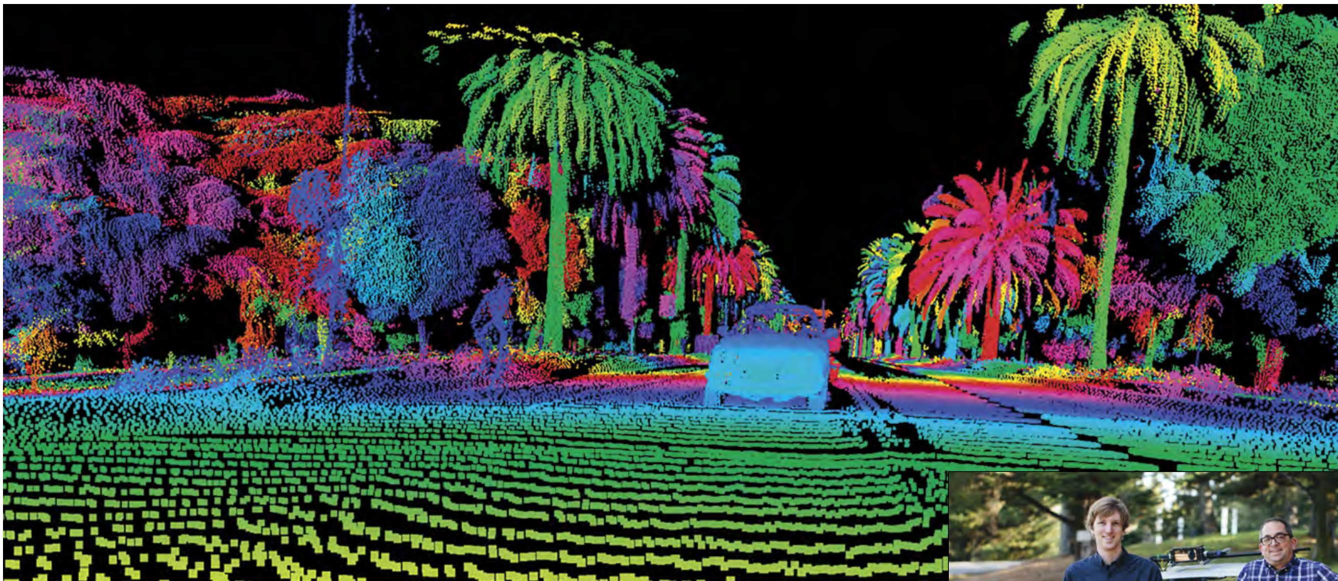
"Review of head-worn displays for the next-generation air transportation system" by Jarvis (Trey) Arthur et al. at NASA Langley Research Center is an open-access summary of the results of NASA's 30-plus years of helmet-mounted and head-worn displays. The study tracks progress in wearable collimated optics, head tracking, latency, and weight reduction, as well as safety, operational, and cost benefits.

Other papers in the special section include:

- "Review of conformal displays: more than a highway in the sky" by Niklas Peinecke et al. at the German Aerospace Center
- "Optical alignment procedure utilizing neural networks combined with Shack-Hartmann wavefront sensor" by Fatime Adil et al. of Aselsan MGEO Division
- "Application of large head-box aircraft transparency distortion measurement and compensation for improved cueing in helmet-mounted displays" by Mark Fischler et al. from Thales Visionix
- "Conformal displays: human factor analysis of innovative landing aids" by Sven Schmerwitz et al. of the German Aerospace Center
- "Optical design of ultrashort throw liquid crystal on silicon projection system" by Jiun-Woei Huang of the National Applied Research Labs in Taiwan.

For more information: **Optical Engineering SPIEdigitalLibrary.org** ■

Lidar for autonomous cars makes optics and photonics "**hot**" again



A view of a city street from the Luminar lidar system.

A new generation of lidar companies supplying the self-driving car industry is putting optics and photonics back at the center of the technology world.

"Photonics is instrumental in making self-driving cars safe and ubiquitous," says SPIE Fellow Jason Eichenholz, cofounder and CTO of Luminar Technologies, a US-based photonics startup that announced in April it is beginning production of a lidar system with an InGaAs design receiver operating at the 1550nm wavelength.

Luminar is one of the newest players in a fast-growing field of around 80 competitors such as Tesla, Google, and Quanergy Systems.

"In the late '90s, optics was king," says SPIE member Louay Eldada, founder and CEO of Quanergy Systems, one of the leading companies working on the technology for autonomous vehicles. "Now it's king again, because of lidar, the hottest area of technology."

Eldada

Both entrepreneurs have years of experience commercializing optics and photonics technologies.

Eichenholz has spent 25 years actively involved in laser, optics, and photonics R&D at Newport, Ocean Optics, Aerosonix, and Open Photonics Inc.

Eldada led the photonics unit at Telephotonics, acquired by DuPont, and was CSO at SunEdison.

He has been with Quanergy since 2012. The company now has 130 employees, with the figure likely to increase to 200 by the end of the year, at 10 locations around the world.

Among Quanergy's 300 partners are the auto giants Mercedes-Benz and Nissan, along with parts firms Delphi and Koito, and sensor component maker Sensata.

Luminar cofounders Austin Russell and Jason Eichenholz.

Luminar has 150 employees after being in "stealth" mode for five years while perfecting a system touted as being able to see at 50 times greater resolution and 10 times longer range than current systems. Cofounded by SPIE member and inventor Austin Russell, it is set to begin a 10,000-unit production run of its lidar system in a Florida manufacturing facility, with deliveries later this year.

SHRINKING THE LIDARS

While lidar systems have become a familiar sight on early versions of self-driving cars, typically sitting rather bulkily on top of the vehicle roof, a key focus today has been to shrink both the size and cost of the technology.

During a standing-room-only keynote talk at SPIE Defense + Commercial Sensing (DCS) in April, Eldada showed a photograph of a Mercedes coupe featuring two of Quanergy's solid-state lidar sensors.

"You don't see the 'lab bench' on the roof of the vehicle," he said. Instead, he held up a small box, the size of two playing cards, containing the core of his product. This is what "hides" behind the grille of the red Mercedes, Eldada told the crowd. That product, which can crunch through half a million data points per second to generate a live view around the vehicle, is Quanergy's "Gen 2" effort. It costs about US$250 in large quantities.

"It's really cheap stuff," he said. "The magic is in the photonic circuitry."

The third-generation version will have all the components on a single substrate, the entire lidar on one chip, he said. "It could go inside every light switch in every home," Eldada claimed.

Eldada predicts that the cost of a lidar sensor — not long ago measured in the hundreds of thousands of dollars — will be just $100 when produced in volume in the future.

ESTABLISHING AUTOMATION LEVELS

Eldada's company has a five-fold mission, the CEO said, to save lives, as well as space, time, energy, and cost. Outside of transportation, its target sectors include security, industrial automation, and 3D mapping.

Interestingly, Eldada took issue with the "Level 1 to 5" system that the industry has adopted in order to describe the level of automation in self-driving cars.

In that breakdown, Level 1 involves minor driver assistance, while at Level 5 the car is entirely autonomous, with no human control, allowing a driver the option of sleeping in the back seat of their vehicle. Level 2 provides automated parking and cruise control to keep a set distance from traffic ahead.

Eldada sees problems at Level 3, where a driver is expected to take over control of a vehicle in certain — perhaps unpredictable and hazardous — circumstances. "Maybe industry should skip Level 3," he suggested. "If someone, say an older person, is taking a nap, and the car says to take over now, that can be a difficult situation."

Most carmakers want the options well defined by them, he added. "For them, at 100 times per second, they want to decide what risks they want to take for the car." ■

LIDAR TO GET YOU THERE SAFELY

◀ *Continued from page 17*

lidar that measured wind profiles at a record 16 km range. The paper pursues two primary enablers for such long-range performance: a high peak-power, narrow linewidth, pulsed laser source based on microstructured erbium-ytterbium-doped fibers and an optimized lidar signal processing chain.

Authors are Agnes Dolfi-Bouteyre, SPIE member Guillaume Canat, Laurent Lombard, Matthieu Valla, Anne Durécu, and Claudine Besson.

In an open-access paper, "Optimization of eyesafe avalanche photodiode lidar for automobile safety and autonomous navigation systems," SPIE member George M. Williams Jr., president of Voxtel, addresses the automotive application.

Williams' objective is to support obstacle avoidance for driver assistance and autonomous navigation through high-definition, three-dimensional mapping. Sensor concepts leveraging 1.5 micron, eye-safe laser sources and avalanche photodiode arrays are shown to support adequate performance out to 150- to 400-meter range.

The next time you encounter unexpected turbulence during air travel or an unaware driver on the highway, you may find some satisfaction knowing that these scientists and engineers are exploring ideas to make your travels safer.

Find the special section on active electro-optical sensing in the SPIE Digital Library: **spie.org/SDLsslidar**. ■

–SPIE Fellow Michael Eismann is editor-in-chief of Optical Engineering *and a member of the SPIE Publications Committee.*

SPIE announces scholarship recipients for 2017–18 academic year

SPIE has awarded US $298,000 in optics and photonics education scholarships for 2017 to 88 outstanding SPIE student members, based on their potential contribution to optics and photonics, or a related discipline.

Through 2016, SPIE has distributed over $5 million in individual scholarships. The awards reflect the Society's commitment to education and to the next generation of optical scientists and engineers around the world. Individual awards range from $2,500 to $11,000.

SPIE Scholarship Committee chair and SPIE Senior Member Jeremy Bos of Michigan Technological University (USA) offered his thanks to all students who applied and congratulated the 2017 recipients.

"Every year, we take on the process of selecting awardees from an incredible group of smart, energetic, talented students," Bos said. "I want to thank the applicants, those who wrote helpful recommendations, and the members of the scholarship committee. I look forward to following the winners and all of our applicants as they contribute to the Society and to our field."

SPIE scholarships are open to full- and part-time SPIE student members studying anywhere in the world. All scholarship applications are judged on merit and the experience and education level of the individual student. High school (pre-university/secondary school) and first- and second-year post-secondary, undergraduate, and graduate students are encouraged to apply and will be judged relative to other applicants with similar educational backgrounds.

For more information on SPIE's scholarship program, a complete list of 2017 scholarship winners, and the criteria used by the SPIE Scholarship Committee in selecting recipients, visit **spie.org/scholarships**.

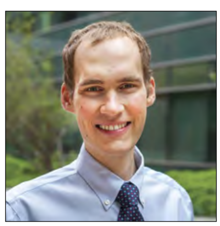
The awards for the 2017-2018 academic year include six named SPIE scholarships.

D.J. LOVELL SCHOLARSHIP

Wright

Logan Wright, a PhD student in applied physics at Cornell University (USA), was awarded the $11,000 D.J. Lovell Scholarship for 2017. His research area is nonlinear wave propagation in multimode optical fibers. The scholarship is named for the radiometry and infrared optics consultant, author of *Optical Anecdotes*, and SPIE Fellow who died in 1984.

JOHN KIEL SCHOLARSHIP



Sawyer

Travis Sawyer, a recent graduate of University of Cambridge (UK), was awarded the $10,000 John Kiel Scholarship. He will begin a PhD in optical sciences at the University of Arizona (USA) in the fall, conducting research into developing a multimodal imaging system for tissue analysis. The John Kiel Scholarship honors SPIE founding member John Kiel, who died in 2014. The scholarship is awarded for a student's potential for long-term contributions in the field of optics and optical engineering.

LASER TECHNOLOGY, ENGINEERING AND APPLICATIONS SCHOLARSHIP

Banet

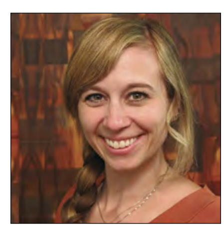
Matthias Banet of the Air Force Institute of Technology (USA) is the recipient of the 2017 SPIE Laser Technology, Engineering and Applications Scholarship, which includes a $5,000 award. He will be starting a PhD in optics in the fall. Banet recently developed the necessary wave-optics simulations to accurately predict the performance of digital holography wavefront sensing in the presence of distributed-volume atmospheric aberrations. He also has expanded his developments to include the deleterious effects of detection noise. The scholarship is awarded in recognition of a student's scholarly achievement in laser technology, engineering, or applications.

TEDDI LAURIN SCHOLARSHIP

Born

Brandon Born, a PhD student in optical design and engineering at the University of British Columbia (Canada), was awarded the Teddi Laurin Scholarship for 2017. He has conducted research in the field of ultra-fast optical switching through his investigation of photonic nanojets. Photonics Media partners with SPIE to fund the $5,000 scholarship to raise awareness of optics and photonics and to foster growth and success in the photonics industry by supporting students involved in photonics. The scholarship is in memory of Laurin Publishing and Photonics Media founder Teddi Laurin.

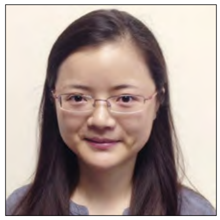
OPTICAL DESIGN AND ENGINEERING SCHOLARSHIP



Tidd

Meg Tidd, a master's student in optical design and engineering at the University of Arizona (USA), was awarded the SPIE Optical Design and Engineering Scholarship for 2017. The scholarship was established in memory of Bill Price and Warren Smith, both well-respected members of SPIE's technical community. Growth in her career as an optical engineer has led Tidd to pursue a graduate program in optical design, with hopes of building on her practical experience to learn new perspectives and develop new design approaches. The scholarship is awarded to a full-time student in the field of optical design and engineering.

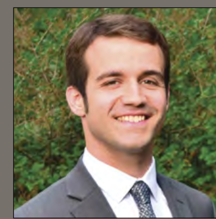
BACUS SCHOLARSHIP



Ou

Jiaojiao Ou, a PhD student in micro/nanolithography and fabrication at the University of Texas at Austin (USA), is the recipient of the 2017 SPIE BACUS Scholarship. The $5,000 scholarship is awarded to a full-time student in the field of microlithography with an emphasis on optical tooling and/or semiconductor manufacturing technologies. Ou's research has focused on mask synthesis and layout optimization for directed-self-assembly and emerging lithography. The scholarship is sponsored by BACUS, the international photomask technical group of SPIE.

Rochester student awarded Kidger scholarship



Papa

SPIE member Jonathan Papa of the University of Rochester (USA) has been awarded the 2017 Michael Kidger Memorial Scholarship in Optical Design.

The $5,000 award will be presented to Papa by Andy Wood, chair of the Kidger Scholarship Award Committee, during the International Optical Design Conference in July.

The 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**.

VOTING ENDS 26 JULY IN 2017 SPIE ELECTION


Greivenkamp


Hartmann


Spiegel


Giger


Boreman


Fiederle


Kaufmann


Kuroda


Mack


Mahadevan-Jansen


Maitland


Sivananthan


Wick

The annual SPIE election for officers and board members will continue through 26 July.

SPIE members eligible to vote will select four new directors, a vice president, and a secretary/treasurer who will begin terms in 2018.

The candidates for vice president are SPIE Fellows: John Greivenkamp, professor of optical sciences and ophthalmology at University of Arizona (UA) (USA), and Peter Hartmann, principal scientist for Zerodur and optical materials at Schott (Germany).

Both are SPIE Press authors who have previously served on the SPIE Board of Directors and numerous SPIE committees.

Greivenkamp is the recipient of the 2017 SPIE Educator Award and has taught geometrical optics to approximately 2000 students at the UA College of Optical Sciences since 1991. He is also the editor of the SPIE Field Guides series and author of the *Field Guide to Geometrical Optics*, published by SPIE in 2004.

He has served on and chaired the SPIE Education and Publications committees and served two terms on the SPIE Board of Directors (1997-1999 and 2012-2014).

Greivenkamp, who has a PhD in optical sciences from UA, is the founder and curator of the UA Museum of Optics.

Hartmann, who holds doctorates from Max-Planck-Institute and University Mainz Germany, is the author of the 2014 SPIE Press book *Optical Glass*. He has worked closely with international standards groups to develop and revise standards and specifications for optical materials and has given numerous workshops and courses on optical metrology, and applications of optical systems.

Hartmann was a symposium chair of SPIE Photonics Europe from 2010 through 2016; chair of the SPIE European Advisory Committee from 2011 through 2014; and member of the SPIE Board of Directors from 2011 to 2013.

The person elected vice president for 2018 will join the SPIE presidential chain, becoming SPIE president-elect in 2019 and president of the Society in 2020.

Video interviews with the vice president candidates can be found at **spie.org/about-spie/2017-vp-election**.

Gary Spiegel, retired from Newport Corp. (USA), is the candidate for secretary/treasurer.

Director candidates, who serve three-year terms, are:

- Michael Fiederle, University of Freiburg (Germany)
- Ken Kaufmann, Hamamatsu (USA)
- Kazuo Kuroda, Utsunomiya University (Japan)
- Chris Mack, Fractilia (USA)
- Anita Mahadevan-Jansen, Vanderbilt University (USA)
- Kristen Maitland, Texas A&M University (USA)
- Siva Sivananthan, University of Illinois at Chicago (USA)
- David Wick, Sandia National Labs (USA)

Other officers, previously elected, are SPIE President-Elect Maryellen Giger of University of Chicago (USA), who will become SPIE president in January 2018, and SPIE Vice President Jim Oschmann of Ball Aerospace & Technologies (USA), who becomes president-elect next year.

SPIE President Glenn Boreman of University of North Carolina at Charlotte and Plasmonics Inc. (USA) will become immediate past president. Boreman will announce the election results at the SPIE annual general meeting in San Diego (USA), 8 August, during SPIE Optics + Photonics. ■

For more information, contact Allison Romanyshyn, SPIE director of executive and administrative services, at **governance@spie.org**.

Designs for interference microscopy objectives earn Zygo scientists Rudolf Kingslake Medal

Two researchers from Zygo Corp. are recipients of the Rudolf Kingslake Medal and Prize for 2016. SPIE presents the award annually for the most noteworthy original paper published in the journal *Optical Engineering*.

SPIE Fellow Peter de Groot, executive director of R&D at Zygo, and James Biegen, a senior technical staff member, are the authors of "Interference microscope objectives for wide-field areal surface topography measurements," an open-access paper published in the July 2016 issue of the journal.

From the fabrication of diesel fuel injectors to patterned semiconductor wafers, surface metrology on the microscopic scale is an essential step in the precision manufacturing of many modern products.

To increase the field of view on current state-of-the-art microscopes for interferometry, multiple obstacles must be addressed, including the size, weight, and form factor of classical interference objectives.

Biegen and de Groot propose a type of low-magnification interference objective that extends the range of application for flexible microscope platforms to larger fields of view.

"The objective comprises a beam splitter plate and a partially transparent reference mirror arranged coaxially with the objective lens system," according to the authors. "The coaxial plates are slightly tilted to direct unwanted reflections outside of the imaging pupil aperture, providing high fringe contrast with spatially extended white-light illumination."


de Groot


Biegen

> "This article is an important response to new requirements in industrial metrology."
>
> —SPIE Fellow Tomasz Tkaczyk, chair of the Kingslake Award Committee

The study features two separate designs; a turret-mountable 1.4× magnification objective parfocal with high-magnification objectives up to 100×, and a dovetail mount 0.5× objective with a 34×34 mm field. Their designs are a practical alternative to the classical Michelson and Mirau type objectives, which have been the standard objectives for most of the history of surface topography interference microscopy.

"The authors of this article deserve the 2016 Rudolf Kingslake Medal and Prize for a useful article with a close-to-perfect overall presentation," says Daniel Malacara Hernández, an associate editor for *Optical Engineering*.

"It is written in a clear and concise style, with excellent reference to the history and state of the art. The results are illustrative and convincing."

Malacara Hernández notes that the paper could be a "wonderful introduction for newcomers to this field as well as students." ■

Tanya Das is new Guenther Congressional Fellow

Tanya Das, a metamaterials researcher and science, technology, engineering, and mathematics (STEM) education activist, has been selected as the 2017-2018 SPIE/OSA Arthur H. Guenther Congressional Fellow.

Das will serve a one-year term, beginning in September, as a special legislative assistant on the staff of a US Congressional office or committee in Washington, DC.

Das is a PhD candidate in Electrical and Computer Engineering at the University of California, Santa Barbara (UCSB) where she works in Jon Schuller's lab. Her metamaterials research explores new ways to manipulate light using nanoparticles.


Das

The Guenther Congressional Fellowship program aims to bring technical and scientific backgrounds and perspectives to the decision-making process in Congress. It provides scientists with insight into the inner workings of the government and gives them opportunities to conduct legislative or oversight work, assist in congressional hearings and debates, prepare policy briefs, and write speeches as part of their daily responsibilities.

In addition to her research, Das explores issues in STEM education through her work in projects to evaluate the effectiveness of new teaching methods in undergraduate engineering courses at UCSB. She has also undertaken projects evaluating the effectiveness of programs to increase retention and graduation rates of STEM undergraduates who come from minority and low-income backgrounds.

Das, who has a BS in electrical engineering, was also part of the workforce development team for the American Institute for Manufacturing Integrated Photonics (AIM Photonics), where she helped to assess workforce needs in the photonics industry.

SPIE.
AWARDS

Early Career Achievement Industry Award

The Early Career Achievement Award is presented in recognition of significant and innovative technical contributions in the engineering or scientific fields of relevance to SPIE.

Two earn SPIE Early Career Achievement Awards

INDUSTRY AWARD

Utkarsh Sharma

SPIE member Utkarsh Sharma, director of the advanced development team at Optovue (USA), has been awarded the SPIE Early Career Achievement Award in Industry, for leadership and innovation, particularly in the successful commercialization of optical coherence tomography (OCT) angiography. He received the award at SPIE Photonics West 2017 in January.

Sharma has "demonstrated an outstanding track record of scientific research, innovation, and technology development that has continued to push the state of the art in the OCT industry," said SPIE Fellow Stephen A. Boppart of the University of Illinois at Urbana-Champaign (USA).

Sharma pioneered a revolutionary imaging technology now commonly known as OCT-based angiography. Some have called OCT angiography the second imaging revolution in ophthalmology, due to its ability to deliver detailed functional vascular networks in the human retina with contrasting dyes.

The technique may replace current imaging procedures for the detection and treatment of a number of diseases, such as glaucoma, age-related macular degeneration, and diabetic retinopathy.

His contributions in industry are illustrated by the successful commercialization efforts of two technological innovations and 22 patents. His scholarly body of work is well cited, with more than 500 citations, and highlights the wide-ranging impact of his research.

He has developed laser systems, fiber optic sensors, and new OCT imaging technologies for a range of applications, including environmental sensing and medical imaging. His work on development of an OCT imaging technology was one of the key technological advancements in the field of endoscopic OCT technology.

"It is clear to me that Dr. Sharma's contributions to the imaging community will help detect eye diseases at an early stage, reduce healthcare costs, and improve patient care worldwide," said SPIE Fellow Ruikang Wang of the University of Washington (USA).

SPIE.
AWARDS

Chandra S. Vikram Award

The Chandra S. Vikram Award in Optical Metrology is given annually for exceptional contribution to the field of optical metrology.

CHANDRA S. VIKRAM AWARD

Mitsuo Takeda

SPIE Fellow Mitsuo Takeda, a professor at Utsunomiya University (Japan), is the 2017 recipient of the SPIE Chandra S. Vikram Award in Optical Metrology. He is honored for the invention of the Fourier transform method of interferogram fringe analysis, achievements in coherence holography, and many industrial applications of three-dimensional shape measurements.

"During more than 30 years of his career in the field of holography and optical metrology, Prof. Takeda has done a lot of innovative work," said SPIE Fellow Christophe Gorecki of the Institut FEMTO-ST in France. "His pioneering work in the development and the establishment of Fourier fringe analysis is extremely important. His contributions are interdisciplinary and international, encompassing a broad area of optical science and technology, and have a large impact."

SPIE.
AWARDS

Early Career Achievement Academic Award

The Early Career Achievement Award is presented in recognition of significant and innovative technical contributions in the engineering or scientific fields of relevance to SPIE.

ACADEMIC AWARD

Maiken H. Mikkelsen

SPIE member Maiken H. Mikkelsen, the Nortel Networks Assistant Professor of Electrical & Computer Engineering at Duke University (USA), is the 2017 recipient of the SPIE Early Career Achievement Award, Academic. She is being honored for outstanding contributions to the understanding of light-matter interactions and ultrafast emission dynamics in plasmonic systems.

"At Duke, she has built from scratch an impressive and advanced laboratory that has allowed her to obtain and publish groundbreaking results on plasmon-enhanced light-matter interactions, including the demonstration of strongly enhanced spontaneous emission rates of quantum emitters," said 2005 Nobel laureate in physics John L. Hall of the University of Colorado at Boulder (USA).

Her research results have been published in *Nature Photonics*, *Nature Communications*, and *Nano Letters*, focusing significant attention on and impacting the fields of nanophotonics, plasmonics, and quantum optics. Her pioneering contributions are expected to define the future of these fields.

"Maiken is highly deserving of the SPIE Early Career Achievement Award," said SPIE Fellow N. Asger Mortensen, professor at Technical University of Denmark. "She has already established herself as a leader in the field of quantum nanophotonics. I am deeply impressed with her vision, innovative ideas, understanding of the natural world, and innate ability to identify research areas with the potential for translational breakthroughs."

Mikkelsen's work points toward solutions to complex and pressing problems, including faster computers, enhanced communications security, simulation of complex structures, and improved solar cells. David R. Smith, director of the Center for Metamaterial and Integrated Plasmonics at Duke, praised the distinctive perspective Mikkelsen brings to her research.

"Her scientific knowledge and practical applications of engineering are brought together into a single line of research," he said, bringing "a fresh approach to long-standing challenges in the field."

Mikkelsen also recently received the Young Investigator Program award from the US Army Research Office and a $2 million research award from the US National Science Foundation. ■

Takeda is among the most recognized experts in full-field optical metrology. He is the author of more than 120 journal papers, nearly 50 invited papers, 10 review papers, seven book chapters, and nearly 20 patents. He has also given 13 plenary and keynote presentations. The 1982 paper he coauthored, "Fourier transform method of fringe pattern analysis for computer based topography and interferometry," has surpassed 2500 citations, according to Web of Science.

He has continued his research in the field of optical metrology, with emphasis on basic principles and industrial applications of optical interferometry, coherent and incoherent light holography, and profilometry. His particular focus is on fringe pattern analysis and image/optical information processing.

His sequential papers on application of Fourier transforms for automatic measurement of 3D object shape, including objects with large height steps and surface isolations, have received nearly 1400 citations. Combined with the 1982 paper, Takeda's work makes up the essential core of full-field optical metrology and related techniques.

Takeda is one of the most innovative and productive scientists in modern optics, said Wolfgang Osten, a member of the SPIE Board of Directors and head of the Institute of Applied Optics at the University of Stuttgart (Germany). "His publication record is very large. However, in his case, quantity and quality are in a well-balanced relation. Several of his publications have stimulated new research fields and motivated many scientists for their own work."

The SPIE Chandra S. Vikram Award in Optical Metrology is given annually for exceptional contribution to the field of optical metrology. The award may be presented for a specific achievement, development, or invention of significant importance to optical metrology or may be given for lifetime achievement. ■

SPIE AWARDS

Members of the photonics community may nominate colleagues for a 2018 SPIE award to recognize their outstanding achievements. Nominations may be made through 24 June 2018 and are considered active for three years from the submission date.

More information on SPIE awards: **spie.org/awards**.

SPIE.
AWARDS

President's Award

An individual who, in the opinion of the President and the Board of Directors, has rendered a unique and meritorious service of outstanding benefit to the Society.

SPIE PRESIDENT'S AWARD

Brian Lula

SPIE Fellow Brian Lula, a member of the SPIE Board of Directors and a past secretary/treasurer for the Society, is the recipient of the 2017 SPIE President's Award. The annual award is presented to an individual who has rendered unique and meritorious service to the Society.

Lula is president of Physik Instrumente USA, a leading manufacturer of piezoceramic-based micro- and nano-positioning equipment for research and applications in industry, such as adaptive optic positioners for astronomical telescopes, semiconductor fabricating equipment, mask alignment and autofocusing mechanisms, and high-resolution microscopy. He previously was a sales director and general manager with Newport Corporation.

The SPIE President's Award recognizes Lula's commitment to SPIE through outstanding service, leadership, guidance, involvement in governance, and public outreach on behalf of the Society.

Lula has had a lifelong passion for telescope making and astronomical imaging that sparked his interest in mechanical engineering. His photo of Elephant's Trunk Nebula in IC 1396 was featured in NASA's Astronomy Picture of the Day in 2007, and another of his astroimages in the design of an SPIE necktie.

Through the years, he has developed relationships with astronomy clubs, schools, and NASA (as above), with the goal of sparking interest in young people to pursue education and careers in engineering and science. He also has spoken at local and national gatherings of amateur telescope makers about the many promising career opportunities for opto-mechanical and electro-optical engineers.

"When young people today express a desire to learn about telescope making, I encourage them strongly to pursue this hobby," Lula said in a 2008 *SPIE Professional* article. "The sky is truly the limit as they consider careers based on optical technologies. Understanding the fundamentals of telescope system design, from optics to mechanics to controls, can vault a young person to the head of his/her engineering or science class."

"It is amazing to me how many of my SPIE colleagues can point to an interest in optics that developed from some interaction in their childhood with telescopes," Lula said.

As secretary/treasurer from 2007-2014, Lula was responsible for financial oversight of SPIE during a period of significant growth as well as major shifts in the global economy. According to SPIE President Glenn Boreman, "the Society owes a debt of gratitude to Brian for his excellent stewardship of SPIE's resources and for his insightful leadership as a member of the SPIE Executive Committee, Board of Directors, and multiple other SPIE committees since 1998."

Lula and other 2017 SPIE award winners will be honored at an awards banquet 9 August during SPIE Optics + Photonics. ■

SPIE DIRECTORS' AWARD

Kenneth M. Hanson

SPIE Fellow Kenneth M. Hanson, a research scientist in the medical imaging field and an accomplished nature photographer, has been selected as recipient of the 2017 SPIE Directors' Award.

The award recognizes Hanson's substantial contributions to SPIE Medical Imaging and to outstanding advancements in medical image quality, restoration, and 3D reconstruction techniques.

Hanson, who has volunteered his skills as a photographer to chronicle the SPIE Medical Imaging symposium for more than 30 years, served as symposium chair from 2002 to 2004. He also served on the program committee for the Imaging Processing Conference from 1984 to 1995 and was the chair of that conference from 1996-2001.

Hanson has worked in various capacities at the US Los Alamos National Laboratory (LANL) since 1975, including more than 20 years in the Dynamic Testing Division where he codeveloped the Bayes Inference Engine, the principal analysis tool for quantitative interpretation of dynamic radiographs. His work at LANL included developing a methodology for quantifying the uncertainties in simulation-code predictions and on the first Advanced Strategic Computing Initiative (ASCI) validation milestone.

His research at LANL also included innovations with tomographic reconstruction from limited image data; inversion of the diffusion equation for optical tomography based on IR photons; new approaches to assess the uncertainties in simulation codes for the verification and validation of simulations; and other basic problems in image analysis.

Although he officially retired from LANL in 2016, he is still a guest scientist in the geophysics group there, working on a project aimed at improving ultrasound breast imaging.

Hanson is the author of 168 publications, including two book chapters and more than 100 papers in the fields of imaging science and tomographic reconstruction. He also used his expertise to help SPIE by developing LaTeX manuscript templates for the Society's proceedings and journals and by teaching an SPIE course on how to write for publications in medical imaging.

"In addition to his substantial contributions to SPIE conferences and publications as a chair, editor, and author, the support Ken provided in developing the LaTeX templates were invaluable in helping SPIE make a successful transition from print publishing to the SPIE Digital Library," said Eric Pepper, SPIE director of publications.

Hanson has received multiple awards including an Outstanding Achievement Award from SPIE in 2004, the US Department of Energy Award of Excellence in 1986, and the LANL Distinguished Performance Award in 1991.

He has a PhD and MS in physics from Harvard University (USA) and earned a bachelor's degree in engineering physics at Cornell University (USA).

Hanson will receive the award 9 August at SPIE Optics + Photonics. ■

SPIE.
AWARDS

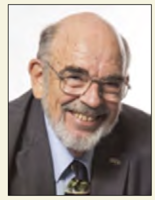
Directors' Award

An individual who, in the opinion of the Board of Directors, has rendered a significant service of outstanding benefit to the Society.

Preview of SPIE Laser Damage 2017


Gruzdev


Ristau


Soileau


Menapace


Exarhos

SPIE Laser Damage, also known as the Optical Materials for High Power Lasers symposium, will celebrate its 49th annual conference in Boulder, CO (USA), 24-27 September.

The long-running conference has produced a series of proceedings papers that has become a comprehensive source of information on optics for high-power and high-energy lasers, laser-induced damage mechanisms and measurements, durability properties modeling, materials testing, component fabrication, and related topics.

SPIE Laser Damage 2017 features a mini-symposium on the sources, effects, and mechanisms of ultrafast laser-matter interactions, a thin-film laser damage competition, a tutorial session on femtosecond laser damage, and poster presentations.

Scientists invited to present at the mini-symposium chaired by SPIE member Vitaly Gruzdev of the University of Missouri (USA) are:

- Louis DiMauro of Ohio State University (USA)
- Zhenghu Chang of University of Central Florida (USA)
- Arnaud Couairon from Ecole Polytechnique (France)
- Stephan W. Koch of University of Marburg (Germany)
- Martin Schultze from Max Plank Institute (Germany)
- Gunter Steinmeyer of Max Born Institute (Germany)
- Kazuhior Yabana of University of Tsukuba (Japan)
- Vladislav Yakovlev of University of Munich (Germany)

Researchers scheduled to present invited talks include Frank Wagner of the Institut Fresnel (France) discussing nanosecond-laser induced multiple pulse damage in different optical materials and Christopher Carr of the US Lawrence Livermore National Lab (LLNL) discussing particle-induced damage on high-energy laser systems. Selim Elhadj of LLNL will report on optical damage of high-performance thin-film transparent electrodes and Marco Jupe of Laser Zentrum Hannover (Germany) will discuss virtual and real materials for interference coatings.

Selected papers presented at SPIE Laser Damage 2017 will be published in a future special section of *Optical Engineering*.

Symposium chairs are Gruzdev, SPIE Fellows Detlev Ristau of Laser Zentrum Hannover (Germany) and M.J. Soileau of University of Central Florida (USA), Joseph Menapace of LLNL, and Gregory Exarhos of Pacific Northwest National Lab (USA).

For moreinformation: **spie.org/LD** ■

Top scientists to gather in December for SPIE Nanophotonics Australasia

Top nanophotonics scientists who are developing new solar cells, better medical devices, and powerful integrated circuits will gather in Melbourne, Australia, 10-13 December for SPIE Nanophotonics Australasia.

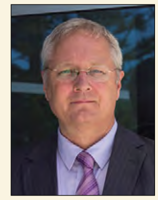
The multidisciplinary forum for nanophotonic technologies, materials, and applications will include oral and poster presentations on new developments in photonics at the nanoscale. Nanophotonics materials to be covered include graphene, perovskite, photonic crystals, metamaterials, organic optoelectronic materials, and quantum materials and phenomena.

While conference planning was still underway at *SPIE Professional* press time, the confirmed plenary session speakers include:

- SPIE Fellow Federico Capasso from Harvard University (USA)
- SPIE Fellow Chennupati Jagadish from the Australian National University (Australia)
- Eli Yablonovich of the University of California, Berkeley (USA)
- SPIE member Benjamin L. Eggleton from the University of Sydney (Australia)
- SPIE member Alexander L. Gaeta of Columbia University (USA)
- SPIE member and SPIE Student Chapter Advisor Yuri Kivshar of Australian National University

Experts from across the globe have also been invited to present their work at a special session on the technologies that will enable the next-generation of organic optoelectronics and photonic materials and devices to help solve environmental and energy problems in society. These technologies include OLEDS and organic PVs, nonlinear polymers, organic sensors, and waveguide materials.


Juodkazis


Moss


Jia


Chon

Session chairs will be Xiaotao Hao and SPIE member Feng Chen of Shandong University (China).

SPIE Nanophotonics Australasia will be held at Swinburne University of Technology, home of the conference and symposium chairs. SPIE Fellow Saulius Juodkazis and SPIE member David J. Moss will chair the symposium. SPIE member Baohua Jia and James W. M. Chon are conference chairs.

For more information: **spie.org/AU**. ■

Warsaw meetings to explore quantum, remote sensing, and security technologies

Remote sensing for agricultural and industrial activities as well as quantum technologies for secure communications and information processing will be a major focus at the collocated SPIE Remote Sensing and SPIE Security + Defence this year.

The two events will be held in Warsaw, 11-14 September. Some 950 engineers, scientists, policy makers, and program managers are expected to take part in the 22 conferences, a poster session, a two-day exhibition, and an all-day industry session on commercial opportunities for photonics in Poland.


Kopczynski


Brown

A joint plenary session Monday 11 September will have two speakers, including Colonel Krzysztof Kopczynski, a head of research at the Institute of Optoelectronics at the Military University of Technology in Warsaw. Kopczynski has led a number of national and international projects using optoelectronic methods and lidar systems for high-energy laser weapons and advanced helmet protection and for the identification of biological contaminants. He will discuss optoelectronics developments in Poland for defense and security.

Also on the plenary stage will be Molly Brown, associate research professor at the University of Maryland (USA) and Chief Science Officer of 6th Grain Global, a private company in Singapore. A former NASA scientist, Brown was the lead author of a 2015 climate assessment report published by the US Department of Agriculture entitled “Climate Change, Global Food Security, and the US Food System.”

Her talk will describe how remote-sensing data and weather information can be combined with household survey and consumption information to better understand the impact of environmental and climate change on food security outcomes.

The industry session on Wednesday 13 September will include an overview of funding in Europe, including for the MIRPHAB pilot line project (Mid InfraRed PHotonics devices fABrication for chemical sensing and spectroscopic applications). Talks will also provide insight into the market for mid-IR sensing and imaging technologies, recent advances in night-vision systems, trends in commercial applications of gallium nitride lasers, and other “dual use” technologies.

EARTH OBSERVATION SYSTEMS

The 24th SPIE Remote Sensing symposium will have more than 600 presentations on the latest systems, technologies, and applications for earth observation. Topics include hyperspectral sensing, next-generation satellites, image and signal processing, and a host of technologies for remote sensing of the oceans, ecosystems, urban environments, and agricultural regions.

Nearly 100 oral and poster presentations are scheduled for a conference on remote sensing for agriculture, ecosystems, and hydrology, with many applications in forecasting weather and increasing agricultural yields. Applications for remote sensing also include water quality measurements, energy conservation, and emergency responses to floods, fires, droughts, and other disasters.

More than 40 countries will be represented at both events.

The chair for SPIE Remote Sensing is Klaus Schäfer of Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research (Germany). Cochairs are SPIE member Christopher M. U. Neale of the Daugherty Water for Food Institute at the University of Nebraska Lincoln (USA) and Stanislaw Lewinski of the Space Research Centre, Polish Academy of Sciences (Poland).

SECURITY AND DEFENSE TECHNOLOGIES

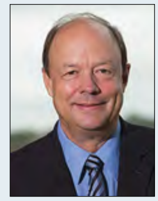
Eleven conferences at SPIE Security + Defence will cover the latest developments in optical materials, data and signal analysis, quantum information science, optronics, hyperspectral sensing, and technologies for millimeter wave and terahertz sensors.

Several joint sessions are planned, including one on components and technologies for quantum devices and quantum metrology, sensing, and imaging.

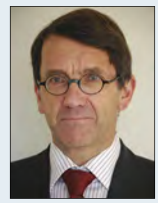
Chairs for SPIE Security + Defence are SPIE Senior member Ric Schleijpen of TNO Defence, Security and Safety (Netherlands); SPIE member Karin Stein from Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB (Germany), and Jan K. Jabczyński of the Institute of Optoelectronics at the Military University of Technology (Poland).

For more information: **spie.org/RS** and **spie.org/SD**. ■

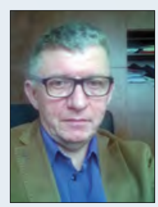

Schäfer


Neale


Lewinski


Schleijpen


Stein


Jabczyński

Optifab returns to Rochester 16-19 October

The city of Rochester, NY, one of the biggest optical manufacturing regions in the USA and the home of the American Institute for Manufacturing Integrated Photonics (AIM Photonics), is once again the host city for SPIE Optifab this year.

With a focus on classical and advanced optical manufacturing technologies, the 16-19 October event will bring together many of the world's experts on optical metrology, materials science, coatings, lithographic processes, and other topics involved in optical fabrication.

Organized by SPIE and sponsored by the American Precision Optics Manufacturers Association (APOMA), Optifab is the largest optical manufacturing conference and exhibition held in the United States.

More than 100 papers will be presented during four days of conference sessions at the Joseph A. Floreano Rochester Riverside Convention Center.

The event also includes plenary talks, a three-day exhibition with product demonstrations, a job fair 17-18 October, poster session, industry sessions, educational courses, and a networking reception. SPIE Corporate member Sydor Optics will host a photonics clambake on Tuesday (tickets sold separately).

Heinrich Grüger, head of the business unit at Fraunhofer-Institute Photonic Microsystems (IPMS) at Dresden (Germany), is scheduled to give a plenary talk on a new approach for the high-volume fabrication of off-axis optical systems on Tuesday, 17 October. The additional plenary speakers were not confirmed as of *SPIE Professional* press time.

Conference sessions during the week will cover design considerations for manufacturability; grinding and polishing; cleaning and inspection techniques; software for the optical industry; optical adhesives; ellipsometry; and new developments in the optical design, manufacturing, and metrology of freeform surfaces and diffractive optics.

Ten courses offered during the week include a half-day session on the proper cleaning, handling, storage, and shipping of optical components along with sessions on geometric dimensioning and tolerancing, scatter metrology for industry, and scratch and dig specification.

Industry sessions include a Wednesday panel discussion addressing the impact of standards on technical and business operations, led by Allen Krisiloff, executive director of the US Optics and Electro-Optics Standards Council. Thursday's industry session will focus on training America's optics technicians and will feature Alexis Vogt of Monroe Community College (USA).

Julie Bentley of University of Rochester (USA), an SPIE Fellow and Member of the SPIE Board of Directors, is the conference chair. SPIE member Sebastian Stoebenau of OptoTech Optikmaschinen (Germany) is cochair.

More information: **spie.org/OFB**. ■

ANNUAL MEETING OF SPIE

The SPIE annual general meeting will be held at 6 pm Tuesday, 8 August at the Marriott Hotel and Marina in San Diego, CA (USA).

SPIE officers will report on activities during the year and results of the SPIE election, and there will be opportunity for members to ask questions about the Society's business.

Annual Awards

The following SPIE awards will be presented at SPIE Optics + Photonics Wednesday 9 August.

- Gold Medal of the Society, Katarina Svanberg (See page 4)
- Early Career Achievement Award – Academia, Maiken H. Mikkelsen (See page 31)
- George W. Goddard Award, New Horizons Optical Instrumentation Team
- Dennis Gabor Award, Toyohiko Yatagai
- GG Stokes Award, Christian Brosseau
- Chandra S. Vikram Award in Optical Metrology, Mitsuo Takeda (See page 30)
- Educator Award, John Greivenkamp
- SPIE President's Award, Brian Lula (See page 32)
- SPIE Directors' Award, Ken Hanson (See page 32)

VR, AR, and autonomous vehicles at SPIE OPTICS + PHOTONICS 2017

How can we change the world for the better? Researchers in optics and photonics technologies are answering this question with world-changing advancements from energy efficiency to healthcare to help us better respond to current and future social and environmental challenges. Many of these innovations will be highlighted at SPIE Optics + Photonics, 6-10 August in San Diego, CA (USA).

This annual event includes 3300 technical presentations in 69 conferences spread among four topical themes: Optical Engineering + Applications, NanoScience + Engineering, Organic Photonics + Electronics, and Optics + Photonics for Sustainable Energy. New conferences this year will cover technologies for quantum photonic devices, quantum nanophotonics, and thermal radiation management for energy applications.

Other activities include a three-day industry exhibition with 180 companies; a two-day SPIE Career Center job fair; 34 courses and workshops; and several networking opportunities for professionals and students.

The San Diego Astronomy Club returns to the SPIE Optics + Photonics' welcome reception Monday night when volunteers will set up a variety of telescopes for participants to view the night sky.

Special events throughout the week include the Optics Outreach Games on Sunday; a panel discussion on space observatories on Monday; a lens design technical event on Tuesday, and the SPIE annual meeting on Tuesday.

On Wednesday night, SPIE President Glenn Boreman of University of North Carolina at Charlotte and Plasmonics, Inc. (USA) will present the SPIE Gold Medal Award and several other awards at the annual awards banquet. (See page 4 for an article on SPIE Gold Medal recipient Katarina Svanberg.)

FAST AND FURIOUS HOT TOPICS


Watzin

As part of a new Hot Topics session Sunday night, James G. Watzin, director of NASA's Mars Exploration Program, will discuss autonomous vehicles and their uses in space and on Earth.

Automakers and technology companies are working fast to develop self-driving vehicles that will transform how people and goods travel from one point to another.


McEldowney

The Hot Topics session will feature four other international experts giving 20-minute talks on how optics and photonics drive innovation in their disciplines:

- Scott McEldowney of Oculus (USA) will speak about augmented and virtual reality (AR and VR).

- SPIE Senior Member Cesare Soci of Nanyang Technological University (Singapore) will discuss quantum devices.
- Nanshu Lu of University of Texas at Austin (USA) will give a talk on bioelectronic wearables and implantables.
- Tanja Cuk of University of California, Berkeley will give a talk on solar fuels.


Soci


Lu


Cuk

The plenary-wide talks at the Hot Topics session will be in addition to five plenary sessions during the week at which 14 speakers will deliver talks on product design, photovoltaics, plasmonics, nanophotonics, optical engineering, CubeSats and other topics.

Among the plenary speakers is Michael Grätzel, the renowned scientist who co-invented the dye-sensitized solar cell. (See list at right.)

Other cutting-edge research will be presented by Zhenan Bao of Stanford University (USA) and her group. The team works on the synthesis of functional organic and polymer materials, organic electronic device design and fabrication, and applications development for organic electronics, including flexible electronic skin.

Invited and keynote talks during the week will include:

- Michael Farle of Universität Duisburg-Essen (Germany) will describe a future in which food is used to activate specific immune reactions in a human body, based on an external noninvasive magnetic stimulus.
- Quantum mechanical effects have pronounced influence on the physical properties of plasmons, and Peter Nordlander of Rice University (USA) will survey a variety of these effects.
- Pantazis Mouroulis of the Jet Propulsion Lab (USA) will review the design principles and techniques behind imaging spectrometer design leading to high spectroscopic data fidelity.

TRIBUTE TO JOE YAVER

Colleagues, friends, and family of the late Joe Yaver will celebrate his contributions to optics and photonics at a gathering Monday afternoon.

Yaver, who died in November 2016, was executive director of SPIE from 1969 until 1993. He is credited with building the foundation for SPIE's current multidisciplinary, international scope, and shaping its place in the photonics industry.

During his tenure, SPIE launched the OE/LASE symposium in Los Angeles, CA (USA), the precursor of SPIE Photonics West, and the Technical Symposium Southeast in Orlando, FL (USA), the forerunner to SPIE Defense + Commercial Sensing.

CAREER-FOCUSED NETWORKING

SPIE Optics + Photonics offers numerous events during the week for career and professional development.

On Monday, 7 August, the SPIE Women in Optics presentation will begin with an overview of the findings in the 2017 Women in the Optics + Photonics Workplace brochure, which will be available onsite. Using results from the *2017 SPIE Optics and Photonics Global Salary Survey*, the brochure includes career advice to help women find success in optics and photonic fields. A member of the SPIE Gender Equity Task Force will highlight ways to improve gender equity, and panel of experts on inclusion will discuss how to increase diversity in science and engineering.

A diversity and inclusion breakfast will also be held Thursday 9 August where attendees can connect and build relationships with others who have similar interests. To attend this free event, email **diversity@spie.org.**

New this year is the Career Lab on Wednesday afternoon. This networking event brings students and early career professionals together with industry professionals and accomplished academics for career advice in optics and photonics.

Along with eight free workshops and panel discussions covering everything from resumes to writing effective scientific papers and funding proposals, student attendees can enjoy a casual networking lunch on Monday with experts who share their experience and wisdom on careers in optics and photonics. Other student events include a Student Chapter Leadership Workshop; Student Chapter Bootcamp; and Student Chapter poster session.

For more information: **spie.org/op** ■

TOP PLENARY SPEAKERS

- Deji Akinwande, University of Texas at Austin (USA), flexible, printable 2D atomic materials and devices
- Leo Baldwin, Amazon (USA), how production quantities influence product design
- SPIE Fellow Larry R. Dalton, University of Washington (USA), hybrid electro-optics and chip-scale integration of electronics and photonics
- Charles Gay, SunShot Initiative, Department of Energy (USA), a history of photovoltaics
- F. Javier García de Abajo, Institute of Photonic Sciences (Spain), controlling light at the atomic scale
- Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne (Switzerland), mesoscopic photosystems to generate electricity and fuels
- SPIE Fellow Naomi J. Halas, Rice University (USA), molecular plasmons
- Steven Kahn, SLAC National Accelerator Lab at Stanford University (USA), optical design of the Large Synoptic Survey Telescope
- Thomas S. Pagano, Jet Propulsion Lab (USA), technologies for hyperspectral infrared remote sensing from space on a CubeSat
- Nam-Gyu Park, Sungkyunkwan University (Republic of Korea), history and progress of halide perovskite photovoltaics
- Ralph Romero, Black & Veatch (USA), bankability of novel energy technologies
- Eicke R. Weber, Berkeley Education Alliance for Research in Singapore (Singapore) and UC-Berkeley (USA), photovoltaics in the terawatt age
- Martin Wegener, Karlsruhe Institute of Technology (Germany), 3D laser nanolithography
- Avideh Zakhor, UC-Berkeley (USA), mapping and visualization platform for 3D modeling

SPIE.

FOLLOW SPIE ON:

EVENTS AROUND THE WORLD 2017

ADVERTISER INDEX

CONTACT US

For information about advertising in SPIE Professional, contact Melissa Farlow at melissaf@spie.org.

Upcoming events and deadlines

Check your monthly SPIE Member E-news for more information on and links to the items below.

JULY

- **15:** Abstracts due for Optical Instruments and Technology (OIT)
- **17:** Abstracts due for SPIE Photonics West 2018
- **26:** Last day to vote in SPIE election

AUGUST

- **4:** Submissions deadline for SPIE Polarization Photo Contest
- **5:** SPIE Student Chapter Leadership Workshop
- **6-10:** SPIE Optics + Photonics
- **7:** Abstracts due for SPIE Medical Imaging 2018
- **8:** SPIE Annual General Meeting
- **21:** Abstracts due for SPIE Smart Structures/NDE 2018
- **21-25:** ICO General Congress
- **28:** Abstracts due for SPIE Advanced Lithography 2018

SEPTEMBER

- **6-8:** International Workshop on Adaptive Optics for Industry and Medicine
- **11-14:** SPIE Security + Defence and SPIE Remote Sensing
- **11-14:** SPIE Photomask Technology + EUV Lithography
- **15:** Deadline for nominations for SPIE Fellow
- **15:** Submissions close for SPIE International Day of Light Photo Contest
- **24-27:** SPIE Laser Damage

OCTOBER

- **9:** Abstracts due for SPIE Defense + Commercial Sensing 2018
- **16-19:** SPIE Optifab
- **28-30:** Optical Instruments and Technology (OIT)

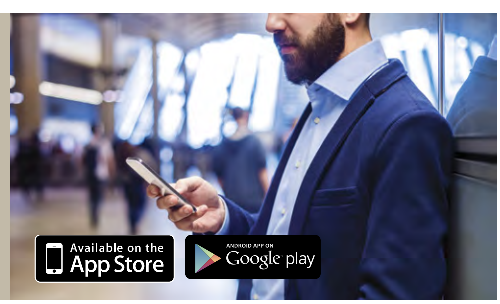
DECEMBER

- **10-13:** SPIE Nanophotonics Australasia

SPIE EVENTS

Find detailed information about SPIE conferences at **spie.org/conferences**

Create your schedule with the SPIE Conference App for iPhone and Android. The mobile app is available at **spie.org/mobile** and at the Android Market and AppStore.



SPIE Event News

Find photos and daily summaries of many SPIE meetings online: spie.org/eventnews

Optimax **Coating**

For High Performance Optics

Coating Capabilities

Attribute	Minimum	Maximum
Diameter	3mm	500mm
Wavelength	193nm	6000nm
Use environment	Vacuum	>80% RH
Durability	Moderate abrasion	Severe abrasion
Measurement	—	68°, s, p, avg. polarization
Laser Damage Threshold	—	>10J/cm^2, 3ns, 1053nm >1MW/cm^2, CW

otr™ Coatings

for extreme environmental resistance

Optimax has developed a unique optical coating (OTR-AR) that protects optical surfaces in the most extreme environmental conditions.

- Stain resistant
- Durable
- Increased life

Download White Paper:
OTR Coatings for Extreme Environmental Resistance

OPTIMAX®
Prototype Optics In One Week

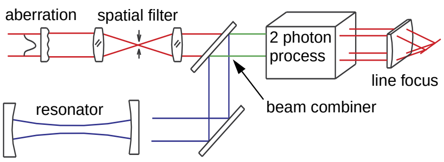
585.265.1020 | sales@optimaxsi.com | **optimaxsi.com**

GLAD

Laser and Physical Optics Design Software

Full diffraction analysis

GLAD is the state-of-the-art in laser and physical optics analysis. GLAD can model almost any type of laser or physical optics system with a complete end-to-end 3D diffraction analysis.



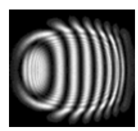
GLAD uses a general description of intensity and phase to perform full diffraction propagation through the most complex systems including detailed treatment of laser gain, nonlinear optics, stable or unstable resonators, diffractive optics, waveguides, fibers and coupling, fiber lasers, photolithography, excimers, optical integrators, etc.

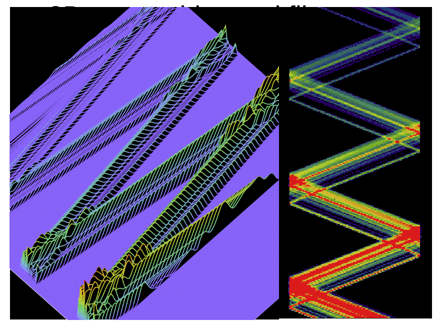
New, Ver. 6.0

- Release: date: May 15, 2017
- Upgrade free with current support
- Captions for graphics
- Global window position reset
- Multiple data sets in `udata`
- Complex numbers, Monitor
- Theory for parasitic Raman

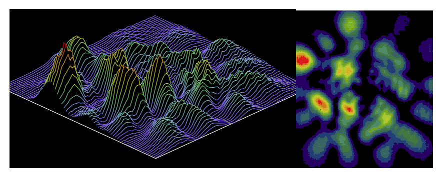
Features:

- Complex, multiple laser systems
- Laser gain models
- Q-switch lasers
- Nonlinear optics
- Interferometry
- Diode pumped lasers
- Stable, unstable, ring resonators
- Lens and mirror arrays
- Binary optics and gratings

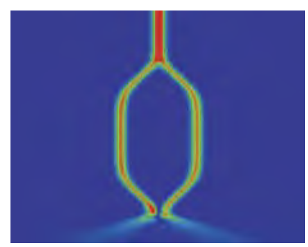




Zigzag resonator in Q-switch laser showing amplification from top to bottom and self-interference at side mirrors.



Transient Q-switch laser mode at 2ns



Photonic switch in the *off* position

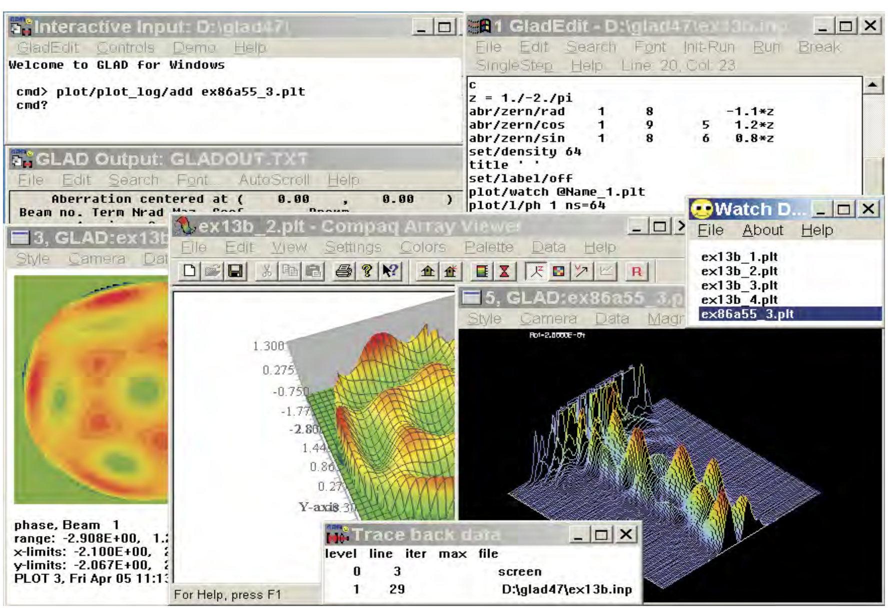
GLAD 3-Day Course

San Diego, Sept. 13, 2017

Technical Support

Excellent technical support, including 中文, for one-year by email and telephone.

Demo: Full-function demo. Send complete address and organizational email to glad@aor.com.



Applied Optics Research

tel: 1 360 225 9718, fax: 1 360 225 0347

e-mail: glad@aor.com, www.aor.com

International Distributors: **FIT Leadintex, Inc.**, Japan
tel: 81 3 3666 7100, sales@fit-leadintex.jp..
Infotek, Shanghai, tel: +86-21-64860708, angie@infotek.com.cn