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GLAD

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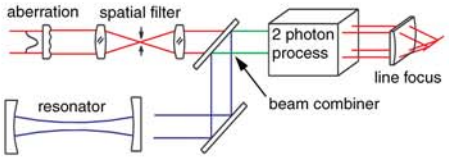

GLAD uses a general description of intensity and phase to perform full diffraction propagation through the most complex systems including detailed treatment of laser gain, nonlinear optics, stable or unstable resonators, diffractive optics, waveguides, fibers and coupling, fiber lasers, photolithography,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

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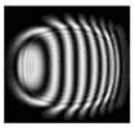
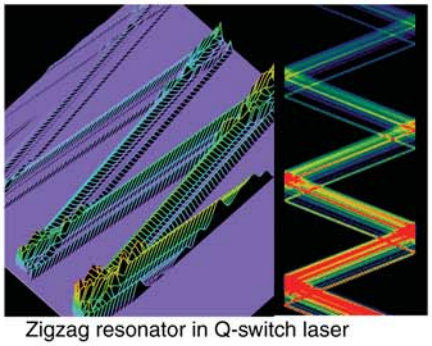
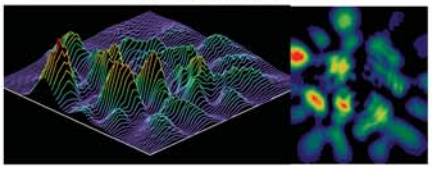
Features:



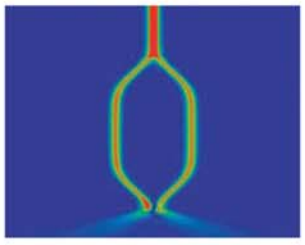
- Complex, multiple laser systems
- Laser gain models
- Q-switch lasers
- Nonlinear optics
- Interferometry
- Diode pumped lasers
- Stable, unstable, ring resonators
- Lens and mirror arrays
- Binary optics and gratings
- 3D waveguides and fibers



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

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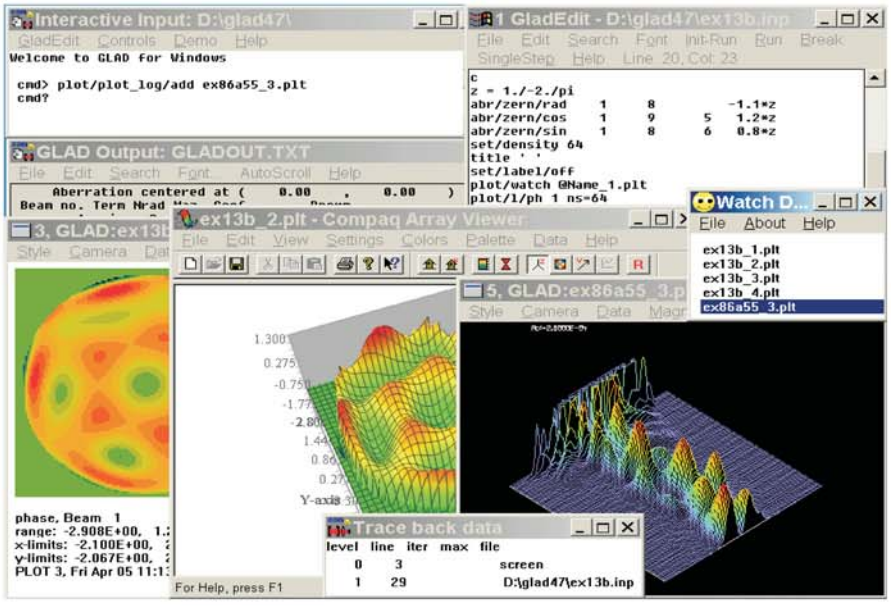

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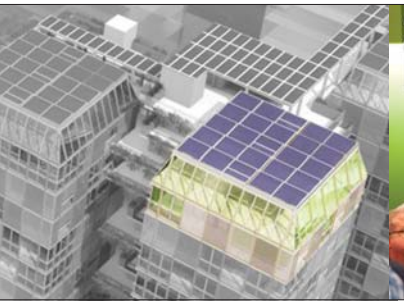
features

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Read *SPIE Professional* online for links, expanded versions of many articles, and more resources.

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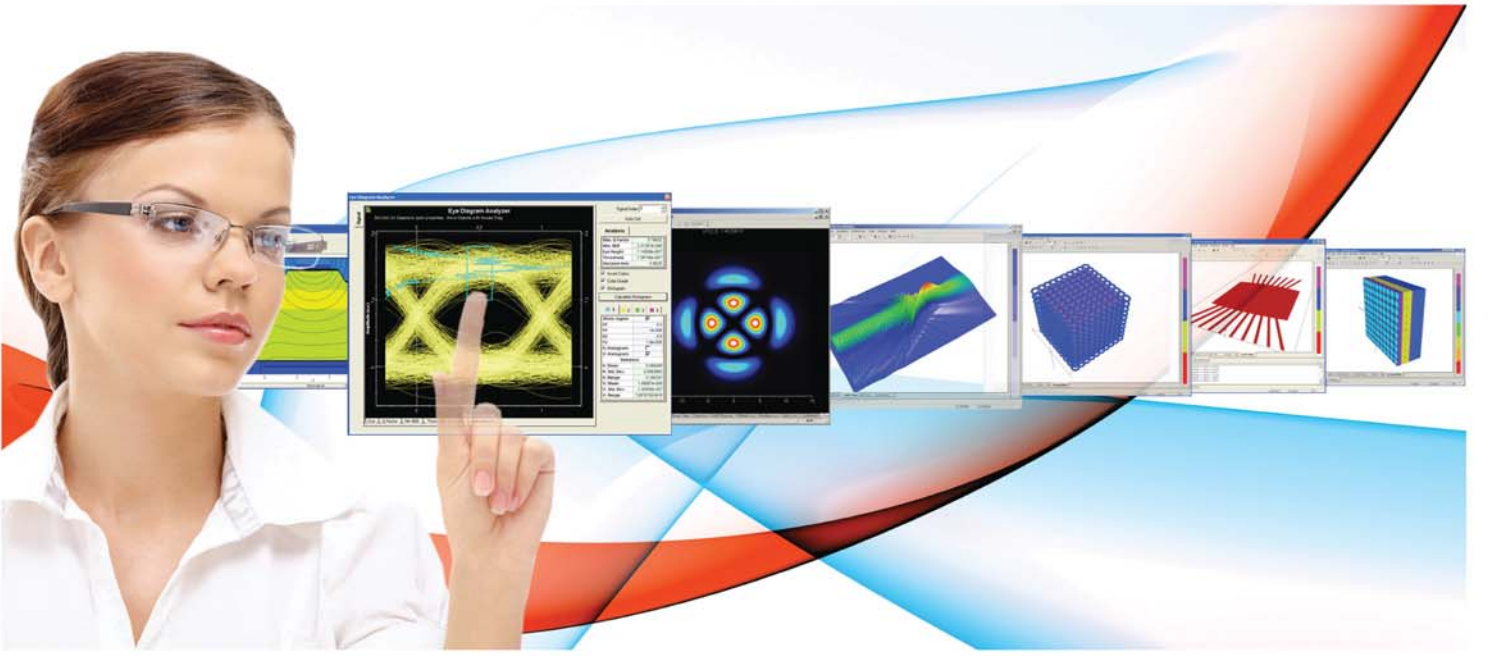
Optiwave

DESIGN & SIMULATION SOFTWARE FOR PHOTONICS



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Bringing light-based technologies into the LIGHT

Many of the world's great wonders and successes are made possible by optics and photonics. Despite the technology's ubiquity, policy and funding decision makers often are unaware of the field's numerous and profound contributions to jobs, economic vitality, health, and community safety.

In the keen competition for public funding and priority setting, technologies that are not well recognized risk being ignored. Many who govern us do not understand the huge impact that innovations such as the laser or the wafer scanner have made on the world's economy.

Progress in nanoelectronics is paced by developments in lithography, enabled by advancements in light sources, lenses, and precision mechanics, and guided by ultraprecise optical metrology.

Chips in smartphones and servers are all literally made by photons. The Internet and the World Wide Web are built on networks of lasers and fiber optics. Images captured by cameras and CMOS devices educate and entertain. Photographs, the precious items most often saved when disasters strike, can be digitally preserved in the cloud: huge server farms wired by fiber and stuffed with processors and memories made by optical lithography.

X-rays and CT scans guide the diagnosis and possible cures for the most terrible diseases. Sunlight is converted to energy by non-imaging optics and silicon.

With such successes, our community should be well known! Sadly, we know it is not. Even our friends and family members often don't even know what we work on or what illuminates our minds.

Our 'essential' technologies

In 2012, the U.S. National Research Council released the report, "Optics and Photonics, Essential Technologies for Our Nation," outlining several important roles our fields play in modern society and identifying important new opportunities in our sphere and adjoining spaces.

Written by a National Academies' committee chaired by SPIE 2006 President and SPIE Fellow Paul McManamon and SPIE Fellow Alan Willner, the report was inspired by the "Harnessing Light" report of 1998, one of the first attempts to quantify the impact that optics and photonics make on our world. Since then, similar reports around the world have helped build awareness of the vital role we scientists and engineers in the light fields play in advancing technology, communications, and health and education possibilities.

The first report had a large impact internationally (see left), and SPIE hopes the new one will as well.

This latest report gives us a new opportunity to show those in policy leadership who we are and what we can do. SPIE is taking the lead, along with other scientific societies including the OSA, the APS, LIA, and the IEEE Photonics Society, in bringing this enlightening message to the forefront.

Photonics initiative for USA?

We are particularly hopeful that the United States will launch a National Photonics Initiative (NPI), as recommended in the "Essential Technologies" report.

The NPI would be a collaborative effort by industry, government, and academia to develop a more integrated approach to managing public and private R&D spending in photonics; advance the research goals put forward in the report; and improve the collection and reporting of R&D and economic data in the field.

In just the last five months of 2012, SPIE hosted and sponsored more than a dozen events in New York, California, Arizona, New Mexico, Alabama, Florida, Washington, DC, and elsewhere to publicize the report and encourage the optics community to communicate with policy makers, business contacts, and others about the enabling and essential role of optics and photonics in the economy.

If you will be attending SPIE Photonics West in San Francisco, I invite you to attend a talk by SPIE Executive Director Eugene Arthurs on government initiatives and opportunities for growth in photonics on Thursday 7 February to learn how you can communicate the message in your organization. See more on page 33.

To read more about optics and photonics as essential technologies or to download the 2012 report: opticsandphotonics.org. ■

William Harwood

William H. Arnold
2013 SPIE President

Assessing the impact of optics

The first National Research Council report in 1998, known as "Harnessing Light," had a large impact internationally, spurring strategic analyses and photonics growth in several economies. SPIE hopes the new U.S. report will have an international impact as well.

Other reports that have helped identify opportunities for photonics include:

- **Photonics21, the European technology platform, has written two strategic research agendas, in 2006 and in 2010.**
- **The Canadian Photonics Consortium issued a 2009 report on "Illuminating a World of Opportunity: Photonics in Canada."**
- **The German "Agenda Photonik 2020" report was issued in 2010.**

Join the discussion: #HarnessingLight on Twitter

Learn more about 2013 SPIE President William Arnold on page 36.

Prism Award finalists named

PRISM20 AWARDS13
PrismAwards.org

Finalists for the 2013 Prism Awards for Photonics Innovation (PrismAwards.org) include sensors for monitoring environmental toxins and detecting explosives, powerful new lasers for manufacturing, and tools for non-invasive imaging deep inside the brain.

Winners of the annual awards, sponsored by SPIE and Photonics Media, will be announced 6 February at SPIE Photonics West in San Francisco.

The Prism Awards recognize photonic products that break with conventional ideas, solve problems, and improve life through the generation and harnessing of light.

An alphabetical list of finalists in nine categories is below.

DEFENSE AND SECURITY

- **OEwaves*:** Micro-Opto-Electronic-Oscillator, information systems on UAVs and other platforms
- **P&P Optica:** PPO HyperChannel, high-resolution detection of explosives
- **Thermo Scientific Portable Analytical Instruments*:** TruNarc, handheld system for rapid narcotics identification

DETECTORS, SENSING, IMAGING, AND CAMERAS

- **Princeton Instruments*:** IsoPlane SCT spectrograph, research-grade imaging spectrograph
- **SPECIM, Spectral Imaging*:** AisaFENIX full spectrum hyperspectral imager, imaging plant health, detecting invasive and illicit species
- **Wasatch Photonics*:** Stroker f/1.3, Raman spectroscopy in such low-light applications as online and industrial settings

GREEN PHOTONICS

- **AdTech Optics*:** DFB QCL 783, air pollution and emissions monitoring
- **LEOSPHERE:** R-MAN510; real-time detection of atmospheric hazards
- **Visualant:** ChromaID, environmental-toxin and food-safety testing

INDUSTRIAL LASERS

- **Aerotech*:** Nmark AGV/CLS, Galvo and controller combination offers Infinite Field of View and >24-bit resolution
- **IPG Photonics*:** GLR-100, single-mode CW green laser for materials processing, solar-cell manufacturing, semiconductor inspection, annealing, etc.
- **TeraDiode:** TeraBlade 2kW High Brightness Direct Diode Laser, beam combining for 1-µm fiber or disk laser brightness and direct-diode wall-plug efficiency and compactness, for industrial metal cutting and welding

LIFE SCIENCES AND BIOPHOTONICS

- **FEMTOLASERS Produktions*:** INTEGRAL Core, small sub-8fs Ti:sapphire laser for biomedicine or industry
- **Olympus America*:** SCALEVIEW Microscope Objectives, seeing farther into the brain
- **Verisante Technology:** Aura, multimodal imaging for skin-cancer detection

MANUFACTURING

- **AFL*:** LZM-100 LAZERMaster, CO_2-laser system for splicing and shaping glass
- **Heidelberg Instruments*:** MicroPG501 Direct-Write Lithography System, desktop maskless lithography tool for small patterns
- **Parian Technologies:** Archetto 3, low-cost nanolithography tool

OPTICS AND OPTICAL COMPONENTS

- **TAG Optics:** TAG Lens 2.0, ultrahigh-speed acoustics to increase depth of field
- **TelAztec:** Anti-Reflection Microstructures (ARMs), suppressing reflection for solar modules, displays, finished optics
- **Tornado Spectral Systems*:** HyperFlux VIS-NIR multimode spectrometer, high-spectral resolution with order-of-magnitude higher photon flux

SCIENTIFIC LASERS

- **Continuum*:** Horizon OPO, full-spectrum spectroscopy research tool
- **FEMTOLASERS Produktions*:** FEMTOSOURCE rainbow CEP4, ultra-stable tool for ultrafast science
- **Insight Photonic Solutions*:** Advanced OCT Swept Tunable Laser, high-performance, low-cost tunable laser

TEST, MEASUREMENT, METROLOGY

- **KMLabs: Chromatis,** fast, accurate characterization of dispersive properties
- **Linden Photonics:** Lindex Optics Cleaners, cleaning media for fiber optics
- **Resolution Spectra Systems:** Zoom Spectra, ultrahigh-spectral resolution for tunable laser control, laser-diode measurement, Bragg component measurement, high-depth OCT

** Indicates finalists who are SPIE corporate members.*

Innovation means business

The Prism Awards for Photonics Innovation celebrate the wide reach of photonics as an enabling technology and the innovative power of the optics and photonics community.

"Photonics inventions help create valuable new jobs in communications, healthcare, manufacturing, security, and entertainment," says Eugene Arthurs, executive director of awards co-sponsor SPIE.

Pointing to the U.S. National Research Council's 2012 report "Optics and Photonics, Essential Technologies for Our Nation," Arthurs noted that just in the United States, public companies focused on optics and photonics create more than $3 trillion of all public-company revenues and 7.4 million of public company jobs.

"The immense pride these companies have in their innovations and the pride they take in being named finalists in the Prism Awards is well-earned," added Laurin Publishing CEO Tom Laurin.

Follow the Prism Awards on Twitter with #PrismPhotonics.

PIONEERS IN Stereolithography

A huge and diverse industry has grown out of the development of stereolithography in the last three decades. Chuck Hull's patented technology has spawned an age of 3D printing where prototypes of airplane wings, musical instruments, auto parts, and medical prostheses can be created on demand in a matter of hours, and printers capable of producing intricate 3D objects can be had for the price of a high-end TV.

Hull, co-founder and CTO of 3D Systems, and Doug Neckers, CEO of Spectra Group Limited (SGL) and a retired photoscience professor, are stereolithography pioneers. They continue to innovate with lasers, imaging software, photochemistry, and other photonics tools to produce technology and systems for fabricating 3D products.

Inventor Chuck Hull

Hull is the inventor of stereolithography (SLA), an additive manufacturing technology also known as optical fabrication, or photo solidification used in 3D printing. SLA is a process of building 3D structures from a computerized design. Multiple thin layers of a liquid UV-curable photopolymer resin are cured, one on top of another, using a UV laser to trace and solidify a pattern and causing each layer to adhere to the layer below. SLA greatly reduced the time it takes for designers and engineers to create a concept design or functional 3D prototype.

After patenting the technology in 1986, Hull founded 3D Systems, which commercialized the first rapid-prototyping system for computer-aided-design software. The company is now a leading provider of commercial and household 3D printers and design-productivity tools for digital manufacturing. 3D Systems' most recent innovation is a $1,300 Cube printer that makes plastic 3D objects such as toys and jewelry and is marketed to consumers, hobby designers, and garage entrepreneurs. Hull calls this latest advancement a "democratization" of access to 3D printing.

Courtesy Jamie Douglas/LLNL

Professor and entrepreneur Doug Neckers

Neckers is the McMaster Distinguished Research Professor Emeritus of Photochemical Sciences at Bowling Green State University (USA) where he founded the Center for Photochemical Sciences in 1985. An expert in the theory and application of polymer photoinitiation for coatings used in medicine and manufacturing, he developed a PhD program at BGSU that not only focused on producing science teachers and researchers but placed an emphasis on collaboration with industry.

Because of Neckers' expertise in photopolymer chemistry and his development of industry-academia relationships, Hull hired him as a consultant in the 1980s to help commercialize stereolithography.

Neckers later went on to form his own company, SGL, combining his technology and business knowledge with SLA to create medical models, bio-coatings, and other materials. Neckers is the author of several papers for SPIE and is editor of SPIE Press Milestones Series *Selected Papers on Photochemistry*.

SPIE Professional recently spoke with Neckers and Hull about the business and science of stereolithography and 3D printing. Their stories are on the next pages.

Additive manufacturing

Lawrence Livermore National Laboratory is among a growing number of organizations with research programs devoted to additive manufacturing technologies like stereolithography.

At its Center for Micro and Nano Technology in California (USA), LLNL develops applications for the Departments of Energy, Defense, and Homeland Security. The lab is planning a major push in the field of additive manufacturing and will also collaborate with U.S. manufacturers to develop efficient technologies for their manufacturing processes.

At left and below are examples of LLNL's printed 3D structures.

Chuck Hull

Chuck Hull is executive vice president and CTO of 3D Systems, a company he co-founded shortly after receiving a patent for a 3D manufacturing process he called stereolithography (SLA). At the time, he was working to develop UV-curable resins for Ultra Violet Products in California.

3D Systems has been extremely successful, reporting revenues of $90.5 million in the third quarter of 2012, a 57% increase over the same period in 2011. It announced in October that it expects about $350 million in revenues for 2012.

Hull has a BS in engineering physics from University of Colorado (USA) and an honorary doctorate in engineering from Loughborough University (UK).

Cellphone covers, shoes, and other articles can be printed with 3D Systems' Cube 3D printer.

What problem were you trying to solve when you developed stereolithography?

In the early 1980s, I wondered if photopolymer chemistry could be imaged to quickly make first-article (prototype) plastic parts, since it took six to eight weeks to get first-article parts from the traditional tool-making and molding processes. And then the design usually had problems, and it had to be done over. Designing in plastic was a very time-consuming and expensive process.

How did your solution lead to a whole new industry of rapid prototyping and the 3D printing of musical instruments, auto parts, and medical implants?

Stereolithography created great interest because it solved the first-article problem; it was a rapid prototyping system. Based on that, the company grew rapidly, expanded the range of stereolithography systems, and also developed lower-cost ink-jet-based 3D printers.

Quite a few competing companies and technologies emerged, each with their own approach to 3D printing. Over the years, 3D Systems continued to develop new types of printers, and the company acquired several other companies and technologies in the field.

Users of 3D printing have been very innovative in many, many fields, which has led to growth and diversity in the field. All of this has led to what 3D printing is today.

How did you approach the technology and chemistry challenges after the initial breakthrough so that your ideas would be fully and successfully commercialized?

The technology required mastering photochemistry, laser optics, optical scanning, precision mechanical mechanisms, machine-control software, 3D image manipulation software, process engineering, and system integration. I created the first stereolithography system by myself in a lab that my employer let me use. This was very basic, but it demonstrated the concept.

Based on that, we formed the new company, 3D Systems, and brought in all the special talent to develop commercial systems.

Were there many impediments to realizing enough users of the technology who had the right skill set to further innovate?

We actually had tremendous interest from the beginning, and our pioneering customers invested right alongside us to learn and help evolve the technology to where it is today. We feel privileged to have worked with so many great innovators and we continue to partner closely with our customers today.

What were some of the purely business challenges you had to overcome as an entrepreneur?

The first was getting investment to move the product forward. Then there is always the challenge of a compelling and sustainable business model. … But this is all well behind us now.

What was the toughest challenge for 3D Systems in creating the Cube 3D printer and making it affordable enough for consumer/home use?

The time was right to deliver an affordable 3D printer for the masses. That and working on great 3D content for anyone and everyone to take advantage of are

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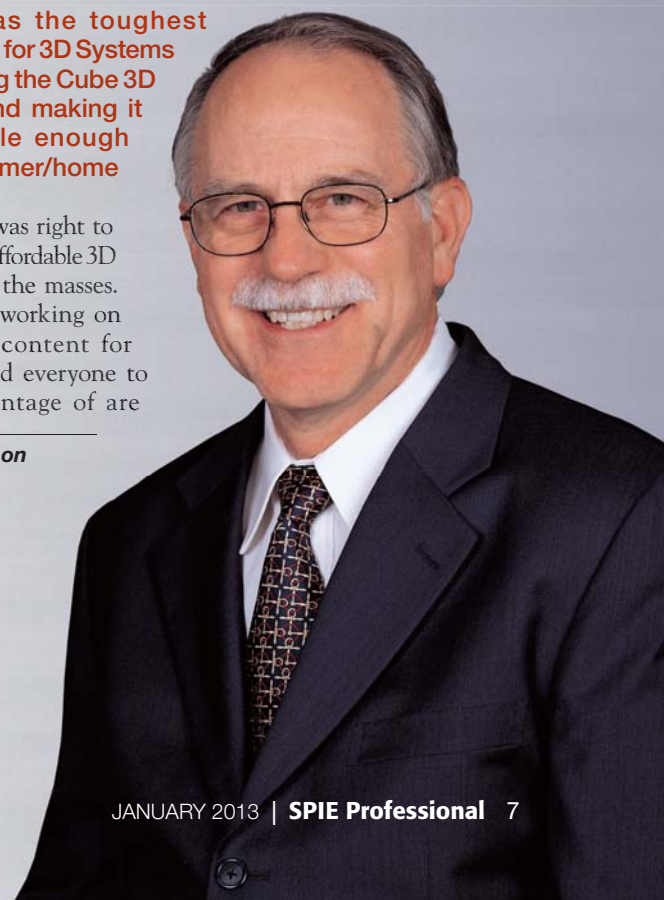


Doug Neckers

By **Stephen G. Anderson**

Nowadays most of us take computer-generated three-dimensional visuals for granted. Aided by powerful small computers and large displays, anyone needing to work with a 3D representation can do so quite easily, be it for work or pleasure. In the early 1980s, though, such tools were not so readily available.

It was at that time, after teaching organic chemistry for many years, that Douglas Neckers (then at the Center for Photochemical Sciences in Bowling Green, Ohio) realized he could use his skills as a photopolymer chemist together with an evolving new laser-based model-making technique called stereolithography. Neckers says the "image" he created was the first-ever three-dimensional medical image, a model of a real human heart.

"I had noticed that chemistry undergraduates from all walks of life were experiencing considerable difficulty visualizing in three dimensions," he explains. "It's an important skill for all organic chemists but especially for any pre-health professionals taking the course. I wanted them to be able to see and plan what they were going to have to do surgically."

So in 1988, using input from an MRI imager and a stereolithography system on loan from 3D Systems, Neckers created a polymer-based model of a real human heart.

Neckers has since retired from Bowling Green University as the McMaster Distinguished Research Professor Emeritus of Photochemical Sciences and is currently CEO of Spectra Group Limited (SGL), an Ohio company he founded in 1990 after creating that first medical replica.

> "At the end of the day I wanted to make sure that the students were educated properly so that they could step into a position that would lead to a very good life for them."

3D prototypes help in medicine

At SGL, again working with 3D Systems and in collaboration with the Cleveland Clinic among others, Neckers used stereolithography to create medical models from a patient's CT scans that surgeons could then use to plan upcoming operations. And not incidentally to him, the company could also provide his students with jobs when they were finished with school. As things turned out, however, because the healthcare reimbursement mechanisms were too slow for a viable business model, SGL has since evolved into the photoscience materials company that it is today.

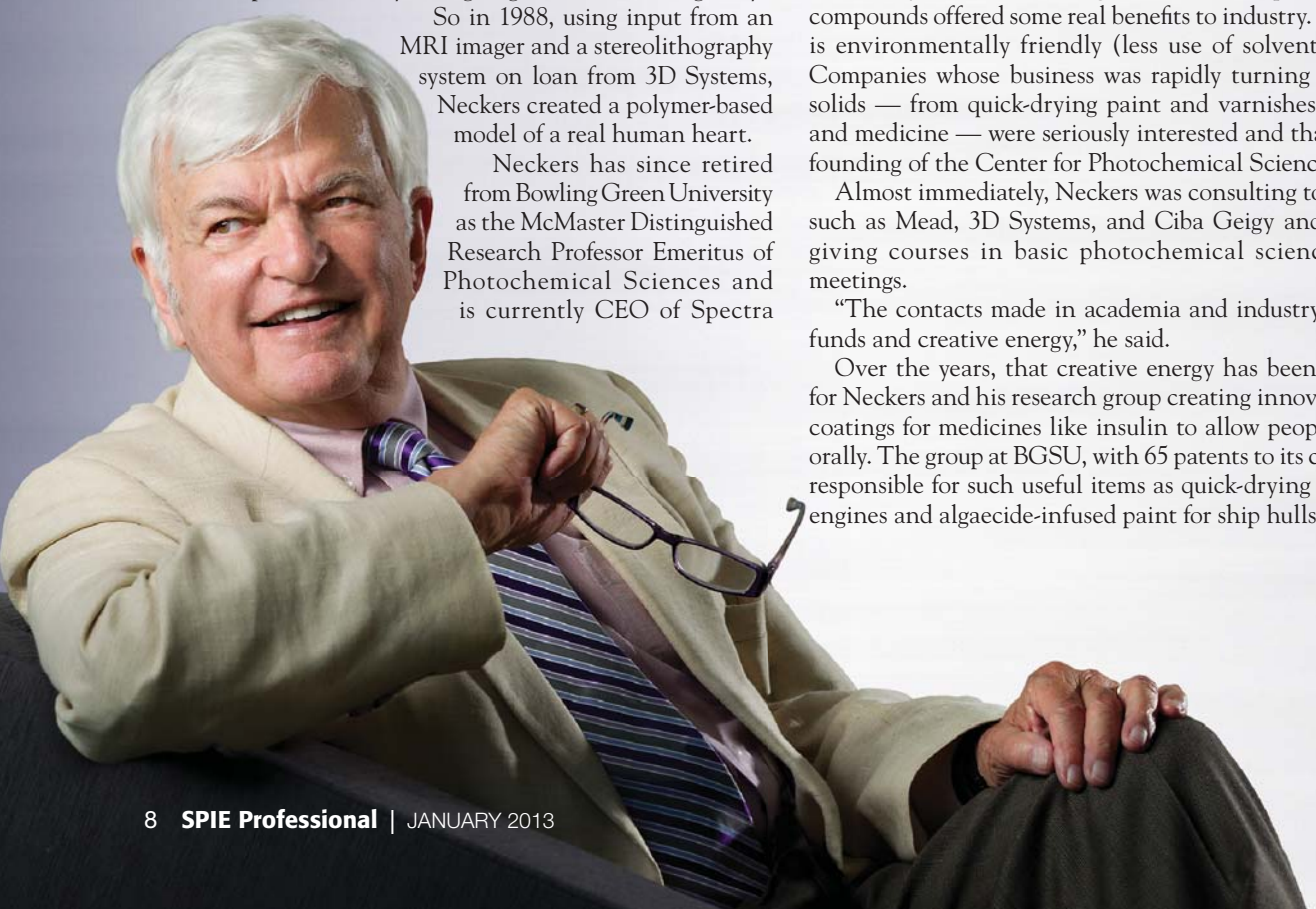
Stereolithography is just one example of photoscience in action. Today photochemistry also has important applications in electronics, photography, printing, and manufacturing.

Early in his career Neckers realized that energy curing (more commonly called UV curing at the time) of photo-sensitized compounds offered some real benefits to industry. The process is environmentally friendly (less use of solvents) and fast. Companies whose business was rapidly turning liquids into solids — from quick-drying paint and varnishes to printing and medicine — were seriously interested and that led to the founding of the Center for Photochemical Sciences.

Almost immediately, Neckers was consulting to companies such as Mead, 3D Systems, and Ciba Geigy and sometimes giving courses in basic photochemical sciences at SPIE meetings.

"The contacts made in academia and industry brought in funds and creative energy," he said.

Over the years, that creative energy has been responsible for Neckers and his research group creating innovative plastic coatings for medicines like insulin to allow people to take it orally. The group at BGSU, with 65 patents to its credit, is also responsible for such useful items as quick-drying coatings for engines and algaecide-infused paint for ship hulls.



Industry, academic partnerships

Neckers attributes the success of the BGSU center to a continuing awareness of industry and its needs. "The collaboration with industry helped build the successful PhD program," he says. "We admitted a broad spectrum of students (not just chemists) and made sure they were trained for jobs and leadership."

It is this overt commitment, not just to teaching and education but to what it leads to, that is a constant in discussions with Neckers. "It's a matter of integrity," he said. "You can't give someone a strong education without ensuring that they then have somewhere to go when they graduate."

Neckers adds, "At the end of the day I wanted to make sure that the students were educated properly so that they could step into a position that would lead to a very good life for them."

Looking forward, Neckers offers some ideas about what may lie ahead. He notes that three-dimensional printing at home is now a reality and wonders how long it will be before news providers offer digital links to three dimensional models that could enhance their stories.

He says that dentistry is a big growth area. Right now photochemistry offers faster curing of fillings, but maybe making teeth in a dentist's office is just around the corner. And he hopes that photoscience will play a larger role in solar energy conversion over the next 5-10 years.

And as for the medical models, Neckers believes fully functional models of, for instance, knee joints, are not too far away while noting that finding materials to behave like the various tissues involved (ligaments, cartilage, etc.) is proving a significant challenge. Nonetheless 3D Systems reports that its medical products in oral, hearing, and orthopedics represent some of its fastest growing markets.

–Stephen G. Anderson is industry and market strategist for SPIE. ■

Additive manufacturing

The U.K. and U.S. governments are among many nations funding programs to accelerate the development and commercialization of laser-based additive manufacturing technologies.

The U.K. Technology Strategy Board will invest £7 million on 3D printing technologies with its "Inspiring New Design Freedoms in Additive Manufacturing" competition.

The United States in 2012 launched a pilot institute to serve as a proof-of-concept for its National Network of Manufacturing Innovation. The pilot institute is located in Ohio and will be focused on additive manufacturing technologies such as 3D printing.

Chuck Hall

◀ *Continued from page 7*

really the main challenges we see in offering a compelling consumer introduction to 3D printing.

Production systems using SLA and selective laser sintering (SLS) still demand a premium in the market because we continue to evolve their capabilities to suit our customers' requirements. The real price breakthrough has been in entry-level systems — delivering great value for the cost — and in our ability to deliver increasing levels of functionality from our years of experience at the high end to the professional 3D-printer market.

I would say that 3D Systems is working hard to democratize access to 3D printing by positioning the right technology at a very affordable price across our growing base of customers and consumers.

What's ahead for 3D Systems? What are the current problems that you and 3D Systems are trying to solve?

We are on a mission to place creative tools into the hands of everyone – without regard for their technical abilities. Put simply, we see a future when everyone can create and make in 3D with true coloring-book simplicity. In the past 25 years, a few hundred thousand people have been able to design with complete freedom of creation. Just imagine what happens when billions of us gain access? The level of innovation and creativity will far surpass anything we know today. That's very exciting.

Courtesy 3D Systems

What are your personal favorite items that have been printed with 3D Systems devices?

The very first cup that was printed is one of my all-time favorite. My wife keeps it with her still today and we will celebrate a 30th anniversary for that part next year. I will tell you that I also received the very first commercial Cube – and immediately printed a neon green iPhone cover – just because!

While there are many amazing things we have printed, when I think back over almost three decades, perhaps the medical model that surgeons used in 2003 to successfully separate the Egyptian twins joined at the head will always remain one of the most important objects to me. ■

Career Advice

SPIE Women in Optics are making a difference.

Women working in the field of optics and photonics are passionate about their profession. They have learned the importance of building and maintaining professional relationships and of moving past obstacles and negative criticism in order to grow in their careers.

SPIE Women in Optics works to promote personal and professional growth for such women through community-building networking opportunities and by encouraging young women and girls to consider optics as a career. The group produces the SPIE Women in Optics monthly planner to showcase the work of women in optics and photonics.

The calendar is distributed free to SPIE members, career counselors, science teachers, and community clubs. To receive a copy, email pascale@spie.org.

The 30 women featured in this year's calendar talk about their job responsibilities, early inspirations, advice they wish they'd received in their early years, and what advice they have for those considering a career in science, technology, engineering, and mathematics (STEM). They represent a wide variety of science and technology occupations, from university professors in the classroom and research laboratory to scientists working on telescopes in the Atacama Desert in Chile.

STEM: The background music

An important focus of STEM education programs around the world is getting students, especially girls, actively engaged in science at an early age. Because of lingering misconceptions about the abilities of women to be successful in science and math, girls are often overlooked in such courses.

"Girls don't have to wait until college to start a career" in optics or in another science field, says SPIE member Rose Soskind, an undergraduate at Rutgers University (USA). "They should start research when they are comfortable and should not be afraid to try new things. Becoming an SPIE student member during high school allowed me to gain valuable research skills, as well as meet and become friends with SPIE members and staff."

Ivy Krystal Jones, a graduate student at Hampton University (USA) who was inspired by the *Star Trek: The Next Generation* television series, advises students to "ultimately embrace the STEM fields as the interdisciplinary background music of scientific discovery."

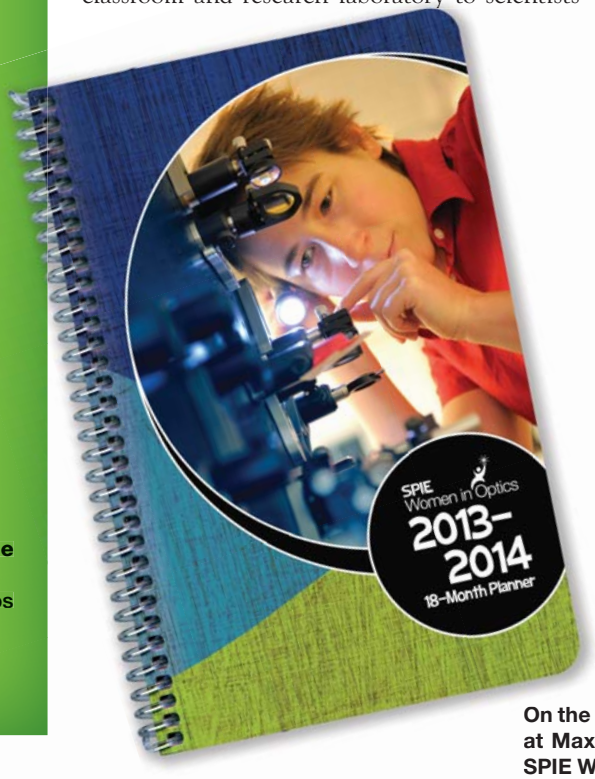
Many of the women in the planner note that finding good advisers and mentors is important when starting out.

"As an undergrad, I was told that women who like physics should be high school teachers," says Alison Peck, deputy project scientist at the Atacama Large Millimeter/submillimeter Array (Chile). "But I knew that I wanted a PhD and a career in research. The right mentors are out there. You just need to be willing to trust your instincts for a while until you find them."

SPIE member Sarah Kendrew, an engineer at the Max-Planck-Institut für Astronomie (Germany), advises girls interested in STEM studies to forge ahead despite obstacles and not to expect special treatment.

"If this is what you want to do — just do it," Kendrew says. "When you become aware of any gender disparity, resist the temptation to think of yourself as a minority or different in any way from your peers.

"Every person has strengths and weaknesses; learn what yours are and don't let yourself be reduced to a stereotype."



On the cover of the calendar is Sylvia Roke in her former lab at Max-Planck für Intelligente Systeme. For a copy of the SPIE Women in Optics calendar, email Pascale@spie.org.

SPIE calendar features 14 members

Of the 30 women featured in the SPIE Women in Optics 2013-14 planner, 14 are SPIE members.

- **Rhonda Albrecht**, Coherent (USA)
- **Hatice Altug**, Boston University (USA)
- **Adela Ben-Yakar**, University of Texas at Austin (USA)
- **Hong Hua**, University of Arizona (USA)
- **Sarah Kendrew,** Max-Planck-Institut für Astronomie (Germany)
- **Anna Grazia Mignani**, CNR – Istituto di Fisica Applicata "Nello Carrara" (Italy)
- **Jessica DeGroote Nelson**, Optimax Systems (USA)
- **Shouleh Nikzad**, NASA Jet Propulsion Lab, California Institute of Technology (USA)
- Student member **Anne-Sophie Poulin-Girard**, Université Laval (Canada)
- **Eva Sevick**, University of Texas Health Science Center (USA)
- Student member **Rose Soskind**, Rutgers University (USA)
- Senior Member **Clementina Timus**, lead physicist, National Institute for Lasers, Plasma and Radiation Physics (retired) (Romania)
- **Carmen Vázquez**, University Carlos III de Madrid (Spain)
- Senior Member, **Fatima Maria Mitsue Yasuoka**, Physics Institute of São Carlos (Brazil)

Gender gap in science

Most people deal with obstacles when starting out in their careers. A recurring theme among the stories in the SPIE Women in Optics calendar is the additional hindrance of gender stereotyping. Since these women have stood their ground and moved forward despite such obstacles, more doors have been opened for women in science.

The stories they share show that while the gender gap has narrowed, it has by no means closed.

When Helen Hall, associate director for program management at the Universities Space Research Association (USA), began her career as an engineer in 1984, there were very few women in the field of thermo-mechanical engineering and she was told that women were bad luck to workers underground.

"I had to work harder to earn their respect," Hall says of her male co-workers. And she did. "I still get phone calls today from the underground miners finding out how I am doing," she says.

SPIE Senior Member Clementina Timus, now retired, was a physicist at the National Institute for Lasers, Plasma and Radiation Physics (Romania). She spent much of her career in an environment that declared equality, but "I can't say that during my career I never felt discrimination," Timus says. "Sometimes I hid my tears."

Women never have to feel inferior, Timus says. "They have to be themselves and be proud to be women. In my opinion, man or woman, we have to keep our identity and never try to be different."

When Gillian Wright started at university, it was still considered unusual for girls to study math and physics. She doesn't point to a specific event but felt the weight of "the cumulative effect of many small things." Despite the social attitudes of the time, she maintained her determination to be a scientist and is now director of the U.K. Astronomy Technology Centre and European principal investigator for the James Webb Space Telescope MIRI instrument.

"The situation is different now," Wright says. "There have been great improvements particularly in the last decade."

Despite changes in attitude, one of the arguments still heard against women pursuing certain careers is the difficulty of handling that career along with the responsibilities of caring for a family.

"Avoid people who try to defeat you with the story that you cannot do a good job because you have a family, husband, kids, etc.," says Anna Grazia Mignani, senior scientist at CNR – Istituto di Fisica Applicata "Nello Carrara" (Italy). "It is a deceitful story and simply not true."

"The women featured in the SPIE Women in Optics planner are making a difference as scientists and engineers in the various fields of optics"

SPIE Board Member **Maryellen L. Giger,** professor of radiology Univ. of Chicago Medical Center (USA).

"It is never too early or too late to make a difference."

Network and start breaking stuff

Another common thread in these stories is the importance of networking. Much of the advice found in the planner touches on learning from others – particularly those who have chosen a similar path.

In her advice to girls considering careers in science, SPIE member Anne-Sophie Poulin-Girard, a PhD student and lecturer at the Université Laval, Center for Optics, Photonics and Lasers (Canada), quotes Eleanor Roosevelt who said, "The future belongs to those who believe in the beauty of their dreams."

Salay Stannard, sales manager and engineer with Joining Technologies (USA) is inspired by the words of Gayle Hagler, environmental engineer with the EPA. After winning a Presidential Early Career Award for Scientists and Engineers, Hagler was asked for her advice to girls interested in science.

"Go ahead and start breaking stuff!" was the answer, because that's how Hagler got her start. And while the women featured in the 2013-14 planner find inspiration in their mentors, colleagues, and students, most are inspired by science itself.

"I was first inspired by the magic of space exploration," says Adela Ben-Yakar, a professor at the University of Texas at Austin, (USA). "I consider space to hold the secrets of our past and future and who we are and what we are made of."

SPIE Senior Member Fatima Maria Mitsue Yasuoka, a researcher for Opto Eletrônica and the Physics Institute of São Carlos (Brazil) says, "I'm inspired by the fact that we can change the world with science." ■

– Karen Thomas, SPIE staff

Panel to discuss mentoring

SPIE member Michelle Xu of University of California, Berkeley (USA) will serve as moderator for the panel discussion, "What Works for You: A Mentoring Panel for Women in Science and Technology" at SPIE Photonics West 2013.

Open to all conference attendees, the discussion on 4 February in San Francisco will feature women pursuing diverse paths to balance career and family.

Round-table sessions with one panelist per table leading the discussion will follow. This event seeks to build mentoring relationships for female graduate students and recent graduates in science, technology, engineering, and mathematics through interaction with those already establishing their careers.

Panelists are

- **SPIE Senior Member Kristen Maitland, Texas A&M University (USA)**
- **SPIE member Mona Jarrahi, University of Michigan (USA)**
- **Desiré Whitmore, University of California, Berkeley (USA)**
- **Jennifer Ellsworth, Lawrence Livermore National Laboratory (USA).**

Contact June@spie.org to reserve a seat at the roundtable discussion.

Impact of U.S. patent reform

Untangling the Gordian Knot of the new "first-to-file" patent rules

By **Rosemarie Szostak** and **Scott Lloyd**

Patents: a way to innovation

Some companies and innovators have viewed the old U.S. patent system as an actual obstacle to innovation because of the proliferation of patent infringement lawsuits, a huge backlog of pending cases, and the limited time an examiner has to prosecute a patent application.

By converting to a first-to-file system, which aligns with other industrialized nations, the United States Patent and Trademark Office anticipates that challenges associated with bringing new technology forward will be minimized.

U.S. President Barack Obama signed the Leahy-Smith America Invents Act (AIA) into law on 16 September 2011. The AIA, after years of debate, transformed U.S. patent law from a first-to-invent system to a first-to-file system, and the shift will be completed on 16 March 2013.

What do these changes mean for inventors and technology businesses?

A little history: U.S. patent law has long provided that a patent may be granted to the first inventor of the claimed invention. This requirement was meant to level the playing field for small companies who were competing with "the big dogs" in advancing technology.

The rationale was that these small, sometimes one-person operations did not have the legal machinery needed to quickly prepare and file patent applications. Unfortunately, the expenses associated with proving inventorship before the U.S. Patent and Trademark Office (USPTO) or federal judges may have offset the desired benefits of the first-to-invent scheme. Inventors of competing technologies ended up having to enter the tangle of regulations and requirements of proving their cases in one forum or another. For many small entities, these proceedings were cost prohibitive and achieved the opposite result from what was intended.

16 March 2013

Inventorship in the United States will be granted on a first-to-file basis for patent applications filed on or after this date.

First to file or disclose

First-to-file is not a unique concept. It is accepted practice for the rest of the world. Conversion to first-to-file puts the United States in step with the patent processes of other industrialized countries. But it is not an exact copy, and that is one rub.

The AIA allows early disclosure during a one-year "grace period" before the application actually hits the patent office to trigger the first-to-file finish line.

What this means is an inventor or company that makes a public disclosure about the invention before filing a patent application could receive a U.S. patent even though another company with the same invention might apply for a patent earlier.

Here's an example: Optics Company A conceives an invention in April and withholds public discussion about it until it files a patent application in September. Optics Company B invents the same technology in May, discloses the invention in a white paper or at a technical conference in August, and files for a patent in December.

Under a true first-to-file system, Optics Company A would win the patent because it was the first to file (in September). But because the AIA provides a one-year grace period after disclosing an invention, Optics Company B would be awarded the patent because its public disclosure of the invention in August would operate as "prior art," barring the patent sought by Company A. Optics Company B must apply for a patent by the following August to preserve its patent rights.

The grace period for public disclosure will necessitate up-front strategic planning in high-reward, high-competition technology areas if international filing is considered.

"The first-inventor-to-file provision of the America Invents Act, one of its hallmarks, brings greater transparency, objectivity, predictability, and simplicity in patentability determinations," according to USPTO Director David Kappos.

At the same time, the USPTO is encouraging its counterparts around the world, especially in Europe, to adopt the grace-period provision. "The grace period has been adopted in many patent systems throughout the world and is recognized as a global best practice," Kappos told a U.S. Congressional Committee in May 2012.

Prior user rights

Another less publicized element of the AIA is the expanded application of "prior user rights" from business process patents to all utility patents. This will protect companies who have already commercialized or are in the process of commercializing a technology claimed in another party's patent application if they prove that they

have been practicing this technology at least a year prior to the filing date.

There are two caveats. Though the company is protected against infringement claims by the entity patenting the technology, it cannot profit through the license or transfer the commercialized technology unless it is part of the sale of the whole company.

Second, in the case of such a sale, the prior-user defense only protects a buyer against infringing activities taking place prior to the filing date or the sale, whichever is later, and only in those locations where the activities were taking place at that time.

First-to-invent
grants inventorship to whoever conceived it first.

First-to-file
grants inventorship to whoever files a patent application first. However, the clock starts ticking if an inventor makes a public disclosure before filing.

Beneficial for innovators?

Concerns over these changes include their impact on promoting innovation, startup company success, flow of venture capital, university technology development, and trade secrets protection. The U.S. Congress asked the USPTO, as well as the Departments of Justice and State, to address these concerns and report to Congress in 2012.

In his testimony before the Judiciary Committee in May, Kappos concluded that, overall, the move to first-to-file was a positive one. He also concluded that limiting prior use to commercialized technology represents a balanced approach to fair use of new technology and is expected to promote manufacturing and jobs.

However, the AIA includes a provision to immunize universities against the prior-user-rights defense in order to allow universities a wider avenue for technology commercialization, an exemption that represents untested waters.

Are these changes in the patent law a good thing or a bad thing for inventors and companies? Sadly, any new kinks and knots introduced into the U.S. patent system by the AIA will not be completely known until they are tested in the federal courts.

Companies, both in the United States and abroad, would be well advised to learn all they can about U.S. patent reform and strategically manage their intellectual property to derive the most benefit from this historic legislation. ■


Rosemarie Szostak and Scott Lloyd are senior analysts with Nerac, Inc., advising clients on technical and intellectual property matters. Szostak has a PhD in chemistry from UCLA and advises companies on energy, materials, and sustainable design. Lloyd is a USPTO registered patent attorney with experience in the biotechnology and pharmaceutical sectors. His JD is from the University of Maryland.

Special challenges for medical patents

SPIE Fellow Dennis Matthews, affiliated with the U.S. National Science Foundation, the University of California, Davis, and Lawrence Livermore National Laboratory, discusses patents and the path to commercialization for medical devices in an SPIE Newsroom video.

Medical technologies and devices are particularly time-consuming to commercialize because of the five to seven years it typically takes to get approval from the U.S. Food and Drug Administration, he says. And startups with an idea for a non-invasive glucose monitor for the growing population of people with diabetes also face stiff competition at the patent office.

Matthews speculates that there must be 10,000 ideas for a non-invasive glucose monitor, "most of which have been patented." He says that an inventor would have to "break the bank" to license all the competing patents and be the one to successfully commercialize such a monitor.

Learn more about why university and government labs face many hurdles before their biophotonics breakthroughs can be made widely available: spie.org/news-matthews.

China No. 1 in patents

China provides attractive incentives for Chinese companies to file patent applications.

As a result, China overtook the United States and Japan in number of patents filed in 2011, according to Thomson Reuters, becoming the world's number one patent publisher.

Lithography patents

Patent attorney Charles Szmanda will discuss the new U.S. patent law in a plenary talk at SPIE Advanced Lithography, 25 February in San Jose, CA (USA).

Hands-on laser "homework" led to biophotonics career

"Great" professors inspired Jin Kang.

Twenty years ago, SPIE Fellow Jin U. Kang was an undergraduate student discovering the theory behind optics and photonics. Although he found the theory interesting, what Kang really loved was building lasers and other optical devices.

Since then, Kang has become a professor and chair of the Electrical and Computer Engineering Department at Johns Hopkins University (JHU) in Baltimore, MD (USA). He conducts research in biophotonics, fiber optics, and optoelectronic devices for applications in medicine and communications.

One of his primary focus areas is developing 3D imaging and sensing systems for guided surgical intervention.

Kang describes one of his latest devices — a "smart" tool with sensors to help guide surgery — in an SPIE Newsroom video interview.

"I got into optics because I had two great professors at Western Washington University (USA), Drs. (Rick) Feinberg and (Joseph) Veit," Kang says. "Under their supervision, I built a pulsed ruby laser for holography and other optical devices, which was an indispensable experience that taught me the fundamentals."

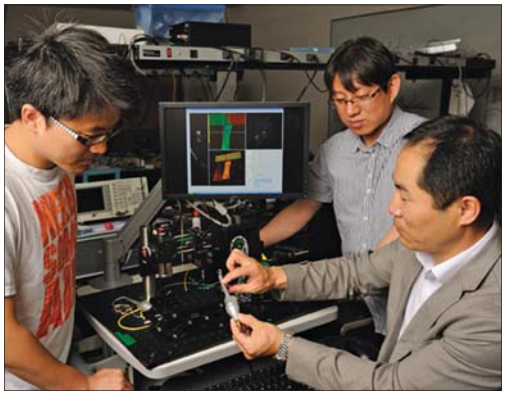
While he liked the courses and theoretical aspects of optics, it was designing and building devices and seeing them work that inspired him to pursue a career in the field. After receiving a physics degree in 1992, Kang then earned an MS and PhD in optical science and engineering at the University of Central Florida.

"It made me really appreciate the science, and made it more enjoyable," Kang says. "I highly suggest that students at all levels get involved with independent projects and design and build something they are interested in."

Smart surgical tool

The smart surgical tool developed in Kang's lab at JHU consists of a laser probe made of a tiny fiber optic cable. Using optical coherence tomography (OCT), the laser emits light that bounces off surrounding tissue — for example, the retina, in the case of eye surgery. The tool processes information about the length of the bounce to create a digital image and to measure the distance between the tip of the fiber and the surface of the tissue.

A motor that controls the movement of the tool tip automatically adjusts the distance of the tip from the tissue to allow surgeons to perform procedures more safely and accurately, compensating for the surgeon's hand tremor and lack of depth perception in microsurgeries.



Courtesy Johns Hopkins Engineering

Jin Kang (right) is developing smart surgical tools that improve human dexterity.

Kang likens his system to automatic stability and traction control systems in modern cars that make driving safe in slippery conditions.

Going forward, he sees the technology being used to enhance the responsiveness and accuracy of surgical robotics as well.

Kang has published over 130 journal articles and 180 conference proceedings papers, including more than 40 with SPIE, and serves on the program committee of the Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications conference at SPIE Photonics West in San Francisco. He is serving on the scientific committee for the first annual International Biophotonics Meeting in Israel in December 2012 where he also is presenting a paper on his ultrafast 3D OCT imaging system.

See the SPIE Newsroom video at: spie.org/jinkang. ■

–Rich Donnelly, SPIE staff

SPIE and "Big Bang" posters

SPIE posters on light-based technologies have begun appearing on the set of the TV series "The Big Bang Theory."

Posters on biophotonics and nanotechnology were shown in an episode of season 6 last November on CBS stations.

The SPIE posters are free to educators and others interested in increasing awareness of optics and photonics. Go to spie.org/posters or send an email to pascale@spie.org.

Photonics Explorer

Motivating youth to pursue optics and photonics in their post-secondary education and future careers has proven to be a challenging obstacle for members of the community today. Photonics Explorer, a program designed to educate children about the fascination of working with light, uses a novel approach that has demonstrated early success among secondary schools in Europe.

Photonics Explorer kits contain mirrors, filters, and other optics and photonics equipment with the aim of engaging, exciting, and educating secondary school students about light-based technologies. The kits emphasize hands-on classroom experiments to demonstrate what can be learned from working with light.

For instance, one experiment designed for older secondary students incorporates a specially designed laser to study diffraction properties and teaches students how to use those properties to measure wavelengths.

An important feature of Photonics Explorer is that kits are easily integrated into the classroom; small groups of students can conduct experiments on the tables in front of them. Many previous education outreach efforts involve class outings and field trips, which can be expensive and more difficult to access.

The program, developed by experienced teachers and science professors, specialists in gender-sensitive material, and photonics experts from 10 European countries, emphasizes teamwork and real-world application of concepts. It has been tested in the local languages of seven European countries: Belgium, Bulgaria, France, Germany, Poland, Spain, and the UK. Over 1500 students participated, and the outcome produced very positive results in a preliminary evaluation by the Leibniz Institute for Science and Mathematics Education.

All of the material for Photonics Explorer, including training courses for teachers, is free to schools. Funding has come from the European 7th Framework Programme, several companies, SPIE, and other scientific organizations.

Individuals offer support for the program through personal skills, mostly as volunteers. SPIE member Amrita Prasad is the CEO of Photonics Explorer. SPIE 2009 President Maria J. Yzuel (Spain) and SPIE Fellow Hugo Thienpont (Belgium) serve on program boards and have been early supporters. SPIE Europe contributes multimedia material for the kits.

More information: www.photonics-explorer.eu. ■

– Hannah Urie, SPIE staff

Journal of Photonics for Energy

Less than two years after its launch, the SPIE *Journal of Photonics for Energy* (*JPE*) has been selected for inclusion in Web of Science and Scopus.

"Inclusion in Web of Science and Scopus will make it easy for scientists and engineers to search the literature in this exciting and important research area — combining photonics with renewable, sustainable energy," says SPIE Fellow Zakya Kafafi, the journal's editor-in-chief.

"This exposure will increase visibility for the journal and for its contributors," she says.

The newest SPIE journal is published in the SPIE Digital Library along with six other SPIE journals that are already included in Web of Science and Scopus.

JPE covers fundamental and applied research areas focused on the applications of photonics for renewable energy harvesting, conversion, storage, distribution, monitoring, consumption, and efficient usage.

A special section on non-imaging optics to be published this spring will focus on thermodynamically efficient optical designs for solid-state lighting and solar energy conversion.

More information: spie.org/jpe

R&D Highlights

EDITOR'S RECOMMENDATION

DNA as nanophotonic scaffolds

DNA continues to fascinate scientists and engineers alike. Not only is it the stuff of life on Earth, but it also is gathering interest as a nanophotonic material because the DNA helix can be manipulated in different ways.

DNA chains can be assembled into wires, thin films, and origami structures or organized into photonic crystals and liquid crystals. It can serve as a molecular ruler and so on.

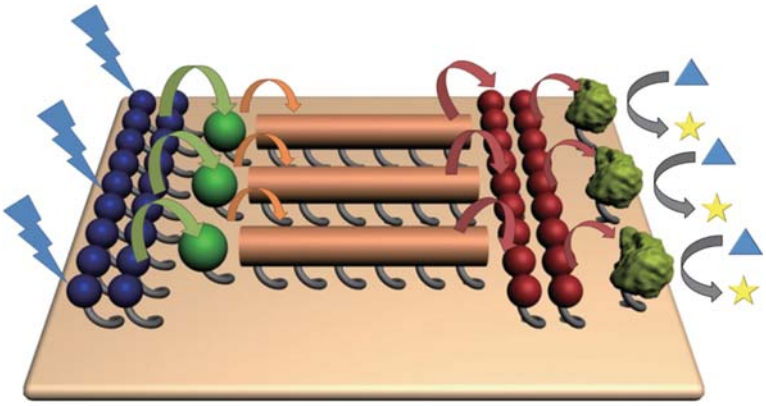
The sources of deoxyribonucleic acid as a material are plentiful; wastes from the commercial fishing industry provide much of the material.

SPIE members Katarzyna Matczyszyn and Joanna Olesiak-Banska of Wroclaw University of Technology (Poland) point out in an open-access review paper published in the Journal of Nanophotonics that DNA can serve as a scaffold for bottom-up assembly of nanoscale devices. Since DNA scaffolds have short-range order, certain reactions are facilitated while others are impeded.

In "DNA as scaffolding for nanophotonics structures," the researchers note that since they are optical materials, DNA scaffolds can also regulate photochemistry. As it is soluble in many organic solvents, DNA itself can be modified and incorporated in optoelectronic and nanophotonic devices, the researchers report.

The combination of molecular biology and supramolecular chemistry with optoelectronics is an emerging research area.

The *Journal of Nanophotonics* is an electronic journal focusing on the fabrication and application of nanostructures that facilitate the generation, propagation, manipulation, and detection of light from the infrared to the ultraviolet regimes.



DNA's specific organization allows for the construction of photonic molecular systems, such as what is schematically shown above. Light-harvesting systems, for instance, can be arranged in a specific order, where the sequence of energy- or charge-transfer processes leads to optimum performance of channeling to create a new generation of photonic wires or conducting plasmonic devices.

Blue, green, and red balls and orange bars represent the photonic components that can serve as light-harvesting and energy-transfer materials. Other components can act as molecular sensing units by energy or electron accepting, where the light is converted to chemical potential, represented by the transformation of the substrate-triangles to the higher-energy product-stars.

Source: *Journal of Nanophotonics* **6**, 064505 (2012); doi:10.1117/1.JNP.6.064505 (ow.ly/fSTbr) ■

–*Akhlesh Lakhtakia, editor-in-chief,* Journal of Nanophotonics

RECOMMENDED IN JOURNAL OF BIOMEDICAL OPTICS

Researchers eye photoacoustic imaging

An international team led by Hao Zhang of Northwestern University (USA) has recently produced a multimodal imaging system that combines scanning laser ophthalmoscopy, fluorescein angiography, optical coherence tomography, and photoacoustic ophthalmoscopy into a single imaging system to provide optical absorption, optical scattering, and fluorescence properties of the retina.

Zhang and co-authors of an article published in a special section on photoacoustic imaging and sensing in the *Journal of Biomedical Optics* used the new imaging platform to demonstrate high-quality in vivo images acquired from both albino and pigmented rat eyes. The demonstration showed the usefulness of the complementary optical contrasts to provide comprehensive anatomic images of the retina.

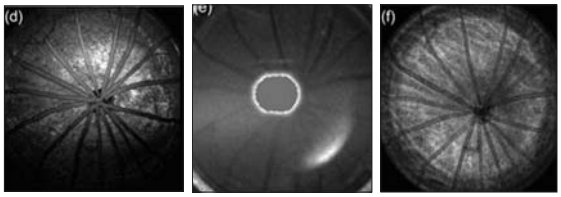
Such multimodal imaging systems hold promise for both fundamental investigation and clinical diagnosis of several blinding diseases such as glaucoma.

Zhang is assistant professor of biomedical engineering at Northwestern and director of the Functional Optical Imaging Lab there.

Co-authors of "Integrating photoacoustic ophthalmoscopy with scanning laser ophthalmoscopy, optical coherence tomography, and fluorescein angiography for a multimodal retinal imaging platform," include Wei Song of Northwestern and Harbin Institute of Technology (China); Qing Wei, Tan Lieu, and David Kuai of Northwestern; Janice M. Burke of Medical College of Wisconsin (USA); and SPIE member Shuliang Jiao of University of Southern California (USA).

Source: *Journal of Biomedical Optics* **17(6),** 061206 (2012); doi:10.1117/1.JBO.17.6.061206 (ow.ly/fiHUL). ■

– Ruikang Wang, member of Journal of Biomedical Optics *editorial board.*



In vivo multimodal retinal imaging of an albino rat when the scanning-laser ophthalmoscope (SLO) worked in the reflection mode. Panels are photoacoustic ophthalmoscopy (PAOM) fundus images showing retinal (RV) and choroidal (CV) vessels (left); reflection-SLO images (middle); and en face spectral-domain optical coherence tomography (SD-OCT) (right).

NIF power

In an experiment last September at the National Ignition Facility (NIF) in California, 192 laser beams were, for the first time, used on a solid target while a suite of 26 diagnostic instruments kept watch.

"From the point of view of showing the facility's capability, it was spectacular. Everything worked," NIF director Ed Moses told Nature.com.

The target capsule deliberately wasn't stocked with the mix of isotopes needed for fusion to occur, *Nature* reported. The power of the shot was well short of that needed for ignition because of concerns that the optical elements used to focus the beams might be damaged by anything higher.

Laser news

Read about the latest developments in laser technology and business news about international laser companies.

- The SPIE Newsroom: spie.org/news-lasers
- Proceedings of SPIE Laser Damage 2012: ow.ly/fSWgi
- News and photos from SPIE Laser Damage 2012: ow.ly/fktUa

R&D Highlights

Laser damage remains hot topic for high-power laser development

Unwanted laser damage of optical materials, first reported in 1964, continues to limit the output energy and power of pulsed and continuous-wave laser systems. Despite nearly 50 years of research in this area, including tremendous advances in damage-resistant optical materials, interest from the international laser community in laser-damage issues remains high and does not show signs of diminishing.

This interest is evident from the high level of attendance at the annual SPIE Laser Damage symposium. Presentations at the September 2012 event covered various aspects of laser-induced damage and materials for high-power laser development including damage-measurement protocols and standards, damage in optical coatings, damage mitigation, nonlinear optical and laser host materials, photonic bandgap materials, materials characterization, surface and bulk defects, contamination of optical components, and thermal management of high-power lasers.

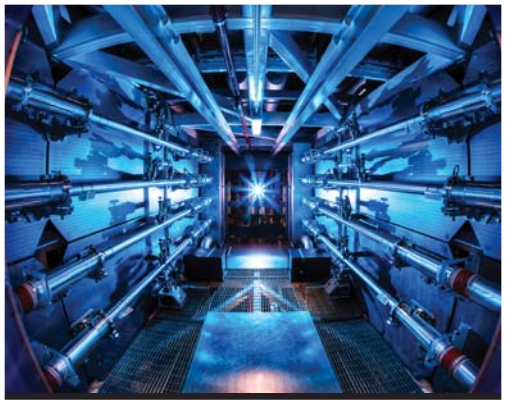
The SPIE journal, *Optical Engineering*, has also just published a special section on laser damage research in the December 2012 volume. See: ow.ly/fkrOx.

One reason for the growing interest in new approaches to laser damage research is the development of novel laser systems and optical materials. For example, new ultrafast and short-wavelength lasers involve new damage effects, and researchers have to deal with specific damage mechanisms not studied before. As a result, laser scientists frequently require non-traditional approaches to characterization of laser-damage resistance.

NIF a shining example

The brightest example of laser development that involves all aspects of laser damage, including its impact on design, operations, and reliability, is the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory in California (USA). This $3.5 billion project took almost 15 years to start operation of the most powerful laser in the world. Similar projects are under development in France, China, and Japan.

Shining nanosecond laser pulses into a special chamber, the facility has 192 lasers designed to ignite a thermonuclear reaction in a hydrogen target by the formation of hot plasma, releasing as much energy from fusion as could be supplied by several power plants. This enormous amount of energy could potentially replace many present power facilities that burn coal or oil to produce heat. Although NIF has not yet accomplished its ultimate goal, (An experimental shot in September 2012 produced 1 megajoule of the 1.4–1.8 megajoules needed.) ignition looks like a very special job for high-power lasers that cannot be accomplished by other tools or approaches.



Courtesy Damien Jemison/LLNL

The preamplifiers of the National Ignition Facility are the first step in increasing the energy of laser beams as they make their way toward the target chamber. NIF recently achieved a 500 terawatt shot, 1000 times more power than the United States uses at any instant in time.

Among the research presented at SPIE Laser Damage was a talk by James A. Pryatel, the cleanliness protocol manager for NIF. Presenters also addressed recent developments in metamaterials and micro-structured surfaces to replace traditional optical elements such as multi-layer optical coatings that control reflection at surface.

SPIE Laser Damage 2012 was co-chaired by SPIE Fellow M.J. Soileau and SPIE members Gregory J. Exarhos, Joseph A. Menapace, Detlev Ristau, and Vitaly E. Gruzdev. Papers presented at the symposium are available in the SPIE Digital Library at ow.ly/fSWgi.

This year's symposium will be held 22-25 September in Boulder, CO (USA), with abstracts due in April. ■

–Vitaly E. Gruzdev

Pilot study uses SHG microscopy technique to study link between cancer and tissue fiber

A pilot study of a new laser-imaging tool has shown promise for accurately analyzing distinctive fiber patterns in breast-tumor tissue to determine if the cancer has spread.

Writing in the *Journal of Biomedical Optics*, researchers at Johns Hopkins say their preliminary study involving 14 women with aggressive breast cancer has found a relationship between lymph-node metastasis and fiber texture and density in human breast cancers using second-harmonic-generation (SHG) microscopy.

If these "proof-of-principle" findings hold up in testing in hundreds more women with or without metastatic breast cancer, the new tool could potentially be used with other tests to more accurately determine the need for lymph node biopsy and removal in women at risk of metastatic breast cancer.

"Our new diagnostic technique has the potential to help reassure thousands of breast cancer patients that their cancers have not spread to other organs," according to senior investigator Kristine Glunde, an associate professor at Johns Hopkins University School of Medicine (USA). The SHG technique could help people "avoid the risks and pain currently involved in direct inspections of lymph nodes for the presence of cancerous cells," she says.

Cancer imaging experts have known for years that fibrous connective tissue located between cancer cells changes and bunches together as tumors grow and disease spreads, says study co-investigator and Johns Hopkins professor Zaver Bhujwalla.

"Until now, however, we had no proof in principle that such minute and progressive changes outside cancer cells, in the tumor micro-environment or extracellular matrix, could be measured and potentially used to better guide our staging and treatment decisions," Bhujwalla says.

Other authors of the paper, "Collagen I fiber density increases in lymph-node-positive breast cancers: pilot study," are Samata M. Kakkad, Meiyappan Solaiyappan, Pedram Argani, Saraswati Sukumar, Lisa K. Jacobs, and Dieter Leibfritz.

Source: *Journal of Biomedical Optics* **17(11)**, 116017 (2012); doi:10.1117/1.JBO.17.11.116017 (ow.ly/fkz8N). ■

USA seeks opportunities for innovation

The release of the U.S. National Research Council 2012 report, "Optics and Photonics, Essential Technologies for our Nation," at SPIE Optics + Photonics last summer underscored the theme of the Photonics Innovations and Solutions for Complex Systems and Environments (PISCES) conference held a day earlier.

The report highlights the opportunities for those in the optics and photonics community to address global challenges through a "hands across the aisle" approach with the integration of government, industry, academic research, and educational resources.

See more on pages 5 and 33 on how SPIE members are working with other scientific societies to begin building a framework for a national photonics initiative in the United States or visit opticsandphotonics.org

R&D Highlights

Controlled chaos could be key to photonics innovation

By **Akhlesh Lakhtakia** and **Judith A. Todd**

A galaxy of researchers from government, universities, and industry convened during SPIE Optics + Photonics in San Diego last August to participate in a daylong conference, Photonics Innovations and Solutions for Complex Systems and Environments (PISCES). Their purpose was to identify and elucidate strategies for boosting innovation in optics and photonics during the next two decades.

Mathew Burrows of the National Intelligence Council (USA) opened the conference by laying out several possible scenarios for the social, economic, and political states of the world in 2030. The socioeconomic states ranged from very dismal to very progressive, and the political states from strife-torn multipolar to generally cooperative.

The solution to both pessimistic and optimistic scenarios is techno-scientific innovation, Burrows said. Researchers need to devise cost-effective and innovative solutions to complex problems, even those problems with political dimensions. In our increasingly industrialized world, research must be directed toward health, pollution, energy, food safety, and international peace.

> For a disruptive technology to be widely adopted, its products must be inexpensive and a distribution network should be easy to set up.

All PISCES participants from research backgrounds agreed that the science of optics and photonics will play a major role in this research because of its wide reach.

Entrepreneurial mindset needed

Going over the century-long history of surface-plasmon research, SPIE Fellow H. Angus Macleod, cofounder of Thin Film Center (USA), observed that while numerous inventions populate one flank of the "valley of death," the other flank has just a few innovations.

Converting an invention into an innovation requires both an entrepreneurial mindset and an environment that supports commercialization activity, as exemplified from personal experiences by several participants. Among them:

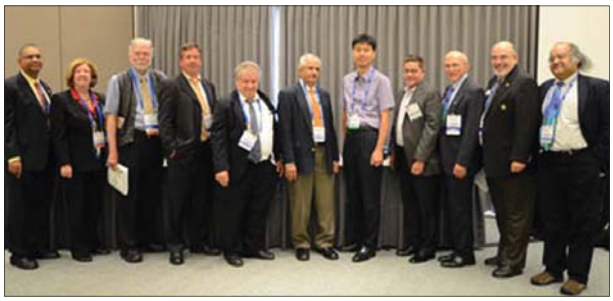
- SPIE Fellow Oleg Lavrentovich, a Kent State University (USA) professor, described his university's considerable success in commercializing liquid-crystal devices invented there.
- SPIE Fellow David Chenault, president of Polaris (USA), described his company's forte in exploiting the surprisingly large amounts of information contained in the polarization of light for new clients and new applications in previously unexplored spectral regimes.
- SPIE Fellow James Trolinger, cofounder of MetroLaser (USA), and colleagues have devised super-resolution holographic techniques to characterize extreme environments in aircraft turbines.
- SPIE member Nelson Tabiryan, cofounder of BEAM Co (USA), discussed the integration of new concepts and thin-film materials into fast nonlinear optical systems with low-power/low voltage requirements.

Are we "swimming in sensors and drowning in data?" wondered SPIE Fellow Paul McManamon, owner of Exciting Technology (USA). Quality data and information are required for proper decisions to be reached. Should research resources be shifted from sensors to processing and automation, particularly for complex military systems such as multi-discriminate ladar?

The propensity to innovate can be inculcated and enhanced en masse, according to M.J. Soileau, a past president of SPIE and founding director of CREOL at University of Central Florida (UCF). The UCF strategy of focusing on key areas, such as photonics, and encouraging partnerships with other universities and industry has positioned UCF as a patent powerhouse producing more than $1 billion in business impact on the region and about 100 patents a year.

Doing science differently

An exciting "Vision 2025" panel discussion and vigorous participation from the audience at the end of the conference identified several strategies to boost techno-scientific innovation in research institutions.



Participants at the 2012 PISCES conference.

Interdisciplinary collaboration was a theme that resonated with all. In defense, for instance, SPIE member Craig Hoffman of the U.S. Naval Research Lab highlighted core optics and photonics innovations in the biological, new materials, free space optical communications, and hyperspectral imaging realms.

An environment which promotes multidisciplinary collaborations to address and solve "big" problems is bound to be innovative because innovations occur at the seams. Such collaborations are often seeded by casual conversations around water coolers, in lunch rooms, and after colloquiums and require incentives to sprout.

How can an individual researcher become more innovative?

SPIE Fellow Yoseph Bar-Cohen of the Jet Propulsion Lab (USA) advised keeping one's eyes always open because inspiration can come from even seemingly insignificant sources. In the same vein, Trolinger suggested that a successful researcher is often a voracious reader, and there are always unintended uses of new technology waiting to be found. No knowledge goes to waste, Chenault agreed.

Do science differently, exhorted the panelists and the audience alike. As intuition can be wrong, devise experiments to challenge assumptions.

Education is key

Only a citizenry with a scientific temperament will be able to address the increasingly complex issues facing the world. How can we educate the next generation of students for the innovation economy?

The Vision 2025 panelists and audience were unanimous in their desire for broader and deeper graduation requirements for proficiency in science and mathematics in U.S. high schools.

Wook Jun Nam of Pennsylvania State University spoke of the importance of education for the photonics workforce, following the educational delivery models being developed at the NSF National Center for Nanotechnology Applications and Career Knowledge at Penn State. Soileau emphasized undergraduate internship experiences in preparing engineers for industry.

The panel ended on an optimistic note, recognizing that the United States has always had a knowledge-based economy that drives innovation. The lack of young U.S. students studying science and technology has been recognized, remediation is in progress, and there was strong optimism about the availability of global talent.

How will the 20-year horizon for photonics innovation be defined?

"Controlled chaos," quipped a participant. Maybe, as Friedrich Nietzsche would have prescribed, a techno-scientifically involved population, broad directions for socially relevant research, spontaneous "interdisciplinarity," and an environment primed for the transformation of inventions into innovative products and services will be the essential ingredients of a controlled chaos that will give birth to many dancing stars.

Papers presented at the 2012 PISCES conference can be found in the SPIE Digital Library: ow.ly/firQ1. ■

Judith A. Todd and SPIE Fellow Akhlesh Lakhtakia are with the Department of Engineering Science and Mechanics at Pennsylvania State University (USA).

Top 10 List

An open-access tutorial aimed at introducing optical engineers to several theoretical advances and practical challenges associated with compressed sensing in optical systems has appeared several times on the monthly "Top 10" download list for *Optical Engineering*, an SPIE journal on R&D in optical science, engineering, and technology.

Through proof-of-concept experiments with a bar target and with video in SWIR systems, American researchers demonstrate how to use compressed sensing, or compressive sampling, concepts to improve contrast and resolution in practical optical imaging settings.

View the current list of popular papers in *Optical Engineering*: opticalengineering.spiedigitallibrary.org

R&D Highlights

RECOMMENDED IN OPTICAL ENGINEERING

Popular compressed sensing tutorial helps engineers reconstruct images

To those who have not wrestled with the highly mathematical roots of compressed sensing, or compressive sampling (CS), theory, CS appears to go against years of deeply ingrained engineering intuition: Full reconstruction of images is possible with significantly fewer samples than allowed by the Nyquist sampling theorem.

This seeming contradiction is one of the main reasons I believe imaging researchers should study CS; some of the deeper truths of sampling may be missing from your toolset.

> Compressive sampling is a mathematical framework for inferring and reconstructing a high-resolution image from a relatively small number of measurements.

Rebecca Willett of Duke University, an early researcher in this field, and co-authors Roummel Marcia of University of California, Merced, and Jonathan Nichols from the U.S. Naval Research Lab have provided the imaging-sensor community with an excellent tutorial on the subject from the perspective of practical optical-imaging systems.

Their *Optical Engineering* paper "Compressed sensing for practical optical imaging systems: a tutorial," has particular implications for the design of IR optical-imaging devices. The paper begins by orienting the readers' intuition regarding how compressive sensing works, noting the fact that we routinely use loss-less compression on images that we store. The fact that images often compress significantly indicates redundant information exists and more efficient acquisition of the data might be possible. This intuition is then reinforced with a short exposition of the main theoretical results from compressive sensing.

Instruments and methods

These theoretical results are easier to grasp through an examination of many of the existing imaging and spectral instruments researchers have used to demonstrate the utility of CS. These instruments demonstrate image-domain and Fourier-domain sampling/encoding techniques that make use of fixed masks and spatial-light modulators. The authors discuss the advantages and disadvantages of each approach.

The *Optical Engineering* paper then surveys methods used for reconstruction of the image (a significant consideration for any CS system) and points out the challenges associated with reconstruction of optical images.

These challenges are primarily the size of images (often greater than 1 megapixel), non-negativity of optical intensity based signals, and photon noise. Video reconstruction is also discussed and the commonalities of CS and super-resolution reconstruction noted.

The authors conclude with applications of coded aperture CS techniques to large-format IR imaging systems in both-single-frame and video modes.

This open-access tutorial paper provides an excellent starting point for gaining a basic understanding of CS as applied to optical imaging and contains excellent references for further study.

Source: *Optical Engineering* **50(7)**, 072601 (2011). doi:10.1117/1.3596602 (ow.ly/fSU7g). ■

–Eddie Jacobs, member of Optical Engineering *editorial board.*

Euclid space mission

The European Space Agency (ESA) is preparing for the Euclid space mission in 2020 to observe the dark energy and dark matter that make up most of the universe.

The spaceborne survey mission dedicated to investigating dark energy, dark matter, and gravity is the only mission dedicated to looking at the dark universe.

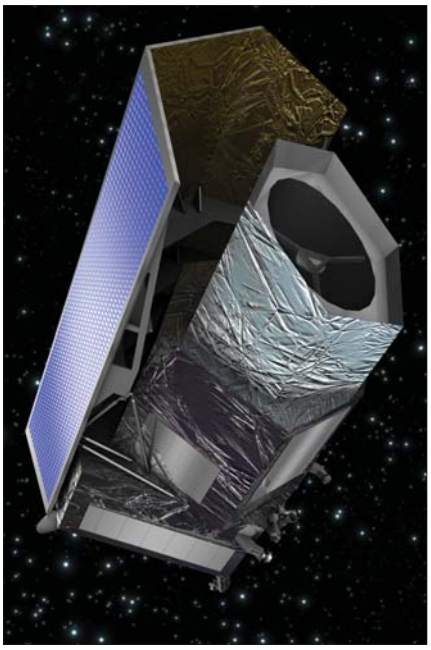
The spacecraft's instruments will characterize the signatures of dark energy on the 3D distribution of cosmic structures and survey the sky at both visible and near-infrared (NIR) wavelengths, making it a wide-field visible/NIR space mission. The six-year mission will conduct a wide survey of one-third of the sky, and a deep survey will cover 1/1000 of the sky.

Yannick Mellier of Institut d'Astrophysique de Paris (France) and René Laureijs, Euclid project scientist at ESA (Netherlands), describe some of the planned instruments and design of the spacecraft in a recent SPIE Newsroom article.

Since the apparent shapes of galaxies are distorted by gravitational deflection of light because of dark-matter concentrations, Euclid will measure the shapes of 2 billion galaxies with a visual imager (VIS) filter, Mellier and Laureijis explain.

"Euclid will also measure galaxy clustering, which is the non-random distribution of galaxies in the universe that results from the force of gravity," the article says. "Galaxy clustering is measured from the 3D position of galaxies using a spectroscopic survey of 50 million galaxies. The distances of galaxies will be derived by using flux ratios of each galaxy in the three Euclid NIR bands and will be complemented by ground-based visible photometry."

To read more about the Euclid space mission in the SPIE Newsroom: spie.org/news-euclid. ■



Courtesy ESA/C. Carreau

An artist impression of the Euclid spacecraft.

OPEN INNOVATION

The case for sharing and harvesting innovations in photonics

By **Henry Chesbrough** and **Jason M. Eichenholz**

Chesbrough

Eichenholz

In the fast-moving photonics industry, new product design and development is crucial for the survival of a company. Companies must continually improve the features, benefits, and performance of their products because of continuous advances in technology, competition, and the changing preferences and needs of customers.

Funding a new R&D project can be a real challenge in today's economic climate. High-profile, capital-intensive R&D projects are investments to expand long-term possibilities but often have to be sacrificed in order to save jobs and workplaces here and now.

Yet, R&D is essential for new product development and can make the difference between a business moving ahead and losing the race.

In the past, R&D was a valuable strategic asset, especially when used as a formidable barrier to entry by competitors. Only large corporations like IBM, DuPont, Xerox, or AT&T Bell Labs could compete by doing the most R&D in their respective industries (and subsequently reaping most of the profits). Rivals who sought to unseat those powerhouses had to ante up considerable resources to create their own labs if they were to have any chance of succeeding via technological advancement.

> "Those who embrace open innovation understand that not all the smart people in the world work for you."
>
> –Jason Eichenholz

These days, however, the leading industrial enterprises of the past are encountering remarkably strong competition from many upstarts. Surprisingly, these newcomers conduct little or no basic research on their own. Instead, they get new ideas to market through a different process.

Open innovation process

New business development processes and the marketing of new products have traditionally taken place within the firm boundaries of a company's linear product-development funnel (Figure 1). Under this closed model of innovation, research projects are launched from the science and technology base of the firm. They progress through the development process, and some projects are stopped while others are selected for further work and advancement. Management and staff are essentially the sole source of new possibilities.

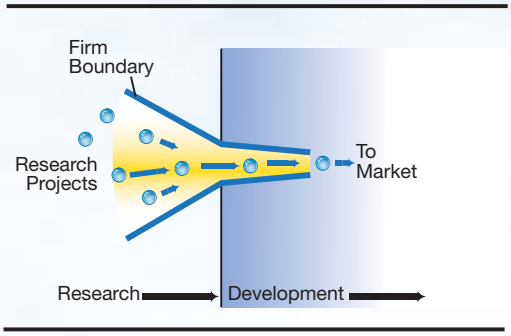
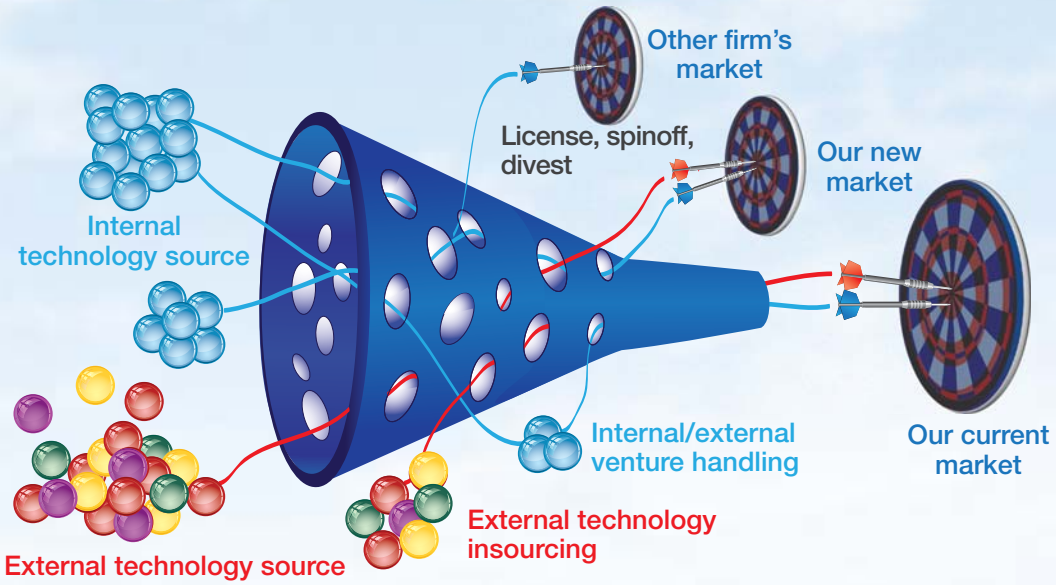


Figure 1: In closed innovation, a company generates, develops, and commercializes its own ideas.

Several factors have led to the erosion of closed innovation and the philosophy of self-reliance in R&D operations. First, the mobility and accessibility of highly educated people has increased over the past 20 years. As a result, large amounts of knowledge now exist outside the research labs of large companies. Also, when employees change jobs, they take their knowledge with them, resulting in knowledge flows among firms.

Second, up until just a few years ago, the availability of angel funding and venture capital increased significantly, making it possible for promising ideas and technologies to be developed outside the traditional boundaries of the firm,



Courtesy Henry Chesbrough

Figure 2: Under the open innovation model, there are many ways for ideas to flow into the process and many ways for it to flow out into the market. Projects can be launched from either internal or external technology sources, and new technology can enter into the process at various stages.

typically in the form of entrepreneurial startup companies. Today, spinoffs, external licensing agreements, and cooperative agreements with suppliers are playing an increasingly important role in the innovation process.

R&D as strategic weapon

Consider Lucent Technologies, which inherited the lion's share of Bell Labs after the breakup of AT&T. Bell Labs was perhaps the premier industrial research organization of the last century, and this should have been a decisive strategic weapon for Lucent in the telecommunications equipment market.

However, things didn't quite work out that way. Cisco Systems, which lacks anything resembling the deep, internal R&D capabilities of Bell Labs, somehow has consistently managed to stay abreast of Lucent, even occasionally beating the company to market.

What happened?

Although Lucent and Cisco competed directly in the same industry, the two companies were not innovating in the same manner. Lucent devoted enormous resources to exploring the world of new materials and state-of-the-art components and systems, seeking fundamental discoveries that could fuel future generations of products and services. Cisco, on the other hand, deployed a different strategy for innovation leadership. Whatever technology, ideas, and intellectual property (IP) Cisco needed, it acquired from the outside, usually by partnering or investing in promising startups (some, ironically, founded by ex-Lucent veterans).

By going outside, Cisco kept up with the R&D output of perhaps the world's finest industrial R&D organization, all without conducting much research of its own.

The story of Lucent and Cisco is hardly an isolated instance. IBM's research prowess in computing provided little protection against Intel and Microsoft in the personal computer hardware and software businesses. Similarly, Motorola, Siemens and other industrial titans with large research labs watched helplessly as Nokia catapulted itself to the forefront of wireless telephony in just 20 years. Nokia built on its industrial experience from earlier decades in the low-tech industries of wood pulp and rubber boots, only to be later eclipsed by companies like Apple, RIM and HTC.

Outside-in and inside-out

Today, open innovation has become the new paradigm for organizing an externally-looking innovation process. Open innovation can be defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively.

Open innovation assumes that companies can and should use external as well as internal ideas and paths to market as they look to advance their innovations and create value. Open innovation business models then define internal mechanisms to claim at least a portion of that value.

Continued on page 26 ▶

Open Innovation

◀ *Continued from page 25*

There are two important kinds of open innovation:

- Outside-in open innovation
- Inside-out open innovation.

Outside-in open innovation involves opening up a company's own innovation processes to many kinds of external inputs and contributions. It is this aspect of open innovation that has received the greatest attention, both in the literature and in industry implementation.

By transforming the meaning of "not-invented-here" inside your photonics company into an outside-in open-innovation development model, you can find new growth opportunities and bring hundreds of researchers from around the world on board to supplement your R&D activities. Likewise, researchers interested in partnering with a company that embraces the power of open innovation have incredible opportunities to change the world and get their science and technology "art" commercialized.

> More and more companies look for new ways to increase the efficiency and effectiveness of their innovation.

With knowledge now widely distributed, companies should acquire inventions or IP from other companies when it advances their business model. With huge investments in photonics R&D around the world, our industry is ideally positioned to leverage the open innovation model to harvest an exceptional variety of quality product and technology-development opportunities.

The lesser-known and practiced open-innovation model, inside-out, describes how organizations can allow unused and under-utilized ideas to go outside the organization for others to use in their businesses and markets. This can mean licensing unused patents and other IP to external users or creating a space within the organizations to nurture innovation and even encourage spinoff ventures under a different business model.

Taking innovation to market

In an open innovation model, as depicted in Figure 2 on the previous page, a company commercializes both its own ideas as well as innovations from other sources, leveraging its traditional market pathways but also seeking new ways to bring these ideas to market via new, external company pathways.

Note that the boundary between the company and its surrounding environment is now porous (like a colander), enabling innovations to move more easily between the two. In many industries, and especially in photonics, the logic that supports an internally oriented, centralized approach to R&D has become obsolete. Useful knowledge has simply become too widespread and ideas must be shared and harvested.

Future innovative companies will successfully convert from Not Invented Here (NIH) to Proudly Found Elsewhere (PFE). Those who can make this transition will have a key advantage in the marketplace.

Intellectual property

In order to properly leverage the open innovation model, you need to think very carefully about the treatment of intellectual property. In the closed model, companies historically accumulated IP to provide design freedom to their internal staff and to avoid costly litigation. As a result, most patents are actually worth very little to these companies, and there is growing evidence (see left) that the vast majority of patents are never used by the business that holds them.

By embracing an open-innovation corporate culture, IP represents a new class of assets that can deliver additional revenues to the current business model. IP can also lead to new businesses and new business models. Open innovation implies that companies should be both active sellers of IP (when it does not fit their own business model) and active buyers of IP (whenever external IP does fit their own product roadmap).

Consider your own organization and evaluate its patent utilization rate. Think of all the patents that your company owns. Then ask yourself what percentage of these patents is actually used in at least one of your businesses.

Often people don't even know the answer because no one has ever asked the question. In cases where companies have taken the trouble to find out, the percentage is often quite low, between 10 and 30%.

This means that 70-90% of a company's patents are not used. In most companies, these unused patents are not offered outside for licensing either. Inside-out open innovation is an obvious opportunity for additional growth and profits.

Integration of ideas

Some may consider open innovation a rationale for outsourcing all R&D. Does this mean I can save costs by firing my R&D team? The answer is no, as this misrepresents the nature of open innovation.

Patents often underused

Although comprehensive studies of patent utilization rates are not yet available, a 2001 Northwestern *University Law Review* article by Mark Lemley cited studies that report a large fraction of patents are neither used nor licensed by firms.

Julie L. Davis and Suzanne Harrison reported in their 2001 book, *Edison in the Boardroom: How Leading Companies Realize Value from Their Intellectual Assets,* that more than half of Dow's patents were unutilized.

And Nabil Sakkab reported in 2002 that less than 10% of Procter & Gamble's patents were utilized by one of P&G's businesses.

In 2006, Sakkab reported that P&G, after moving to an open-innovation model, was able to achieve "sustained and steady top-line growth," with 35% of its new products having elements that originated outside the company.

Contrasting Principles of Closed and Open Innovations

CLOSED INNOVATION	OPEN INNOVATION
The smart people in our field work for us.	Not all of the smart people work for us, so we must find and tap into the knowledge and expertise of bright individuals outside our company.
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value: internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research in order to profit from it.
If we are the first to commercialize an innovation, we will win.	Building a better business model is better than getting to market first.
If we create the most and best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

Often mature companies without large, internal R&D programs rely heavily on acquisitions, strategic alliances, or universities and tap into the innovations of others. But to really transfer knowledge effectively, you need a certain amount of creative abrasion and a certain amount of dwell time and "impedance matching" working together on it.

Companies must still perform the difficult and arduous work necessary to convert promising research results into products and services that satisfy customers' needs. Open innovation works best when you have R&D employees who can collaborate with partners from inside and outside the four walls of your company.

> The photonics industry is ideally positioned to leverage the open innovation model.

Innovative companies have also begun to create positions called "technology scouts" or "innovation scouts," often making that role part of a senior level technical executive job description. That person actively searches for new technologies and ideas outside the firm. However, you need to be able to harness that technology once you find it. Designing and managing these types of innovation communities is going to become increasingly important to open innovation's future.

It is the logic of open innovation that the most successful innovators integrate all their ideas, expertise, and skills and deliver the results to the marketplace, using the most effective and efficient means possible. Whether using ideas from inside or outside the organization, those practicing open innovation will create new value and accelerate their time to market. ■

–Henry Chesbrough, credited with the theory and coinage of the term "open innovation," is executive director of the Program for Open Innovation at the Haas School of Business at the University of California, Berkeley, where he is also an adjunct professor. He is the author of several books, including Open Innovation: The New Imperative for Creating and Profiting from Technology, *and he serves on the business advisory board for Open Photonics Inc. His PhD in business administration and public policy is from the Haas School and his MBA from Stanford.*

–SPIE Senior Member Jason M. Eichenholz is CEO of Open Photonics Inc. and an active evangelist and practitioner of open innovation. He has served as a senior technology leader and executive at several leading photonics companies including Halma, Ocean Optics, and Newport/Spectra-Physics. He has a PhD in optical sciences and engineering from the University of Central Florida where he is also a courtesy faculty member.

Scouting Survey

SPIE Professional covered innovation scouting and open innovation in a 2010 article about a survey conducted by Nerac.

Because innovation scouting is a key element of open innovation, Nerac conducted a 2009 survey to benchmark the practices of innovation and technology scouts.

The survey found that companies in the optics, imaging, and lasers industries reported some of the highest usage of innovation scouts, with 45% of respondents from these industries indicating they have scouting programs.

Furthermore, 100% of those optics and photonics companies reported that their innovation scouting efforts were very successful or moderately successful.

The survey also found a high percentage of employees in scouting roles at optics and photonics companies, compared to employees in other companies. Some 44% of the optics and photonics respondents had more than 25 innovation scout employees, compared to 40% of all respondents who had fewer than three innovation scouts.

Read more about the Nerac survey at spie.org/nerac-scout.

Smart phones get smarter

Photonics For a Better World

Just as the Swiss Army knife is known for its multiple functions beyond cutting and slicing, cell phones are much more than devices for just talking and listening. Advances in optics and photonics technology allow users to take pictures, create videos, play games, and locate their geographical position, just to name a few.

Now common medical diagnostics, such as taking temperature and checking for infections, are being added to the growing list of smart phone capabilities.

Looking inside the ear

One of the most common medical conditions among preschoolers is otitis media or ear infection. These infections are caused either by a virus, which will eventually clear up on its own, or by bacteria, which requires treatment with antibiotics. As physicians in an emergency room will mostly likely see a child only once, they will often give antibiotics for viral infections rather than risk not using them to treat a possible bacterial infection, which could cause complications. Over treatment could lead to antibiotic resistance.

A new device called the Remotoscope allows parents to take pictures of their child's eardrum using a smart phone. An accompanying app magnifies the image and sends it to a pediatrician who can study it remotely.

Developed by researchers at Georgia Institute of Technology (USA) and Emory University (USA), the Remotoscope clips over a phone's camera lens and flash, allowing it to take images of the ear canal. By receiving these images over several days, the physician can wait and see if the infection improves or if antibiotics are needed.

"Parents could receive a diagnosis at home and forgo the late-night trips to the emergency room," says Wilbur Lam, assistant professor of pediatrics at Emory School of Medicine. "Kids who get ear infections early in life are at risk for recurrent ear infections. It can be a very big deal and really affect their families' quality of life."

IR thermometer

Another important aspect of medical diagnoses is taking a patient's temperature. Body temperature plays a valuable role in the assessment of illness, particularly infections. Technology has made this age-old practice quick, efficient, and accurate, but getting a temperature reading can be difficult with a restless child or fidgety patient.

If physical contact isn't possible, a sensor can be used to detect the intensity of the infrared light that naturally emanates from every surface. Since this light is proportional to surface temperature, a microprocessor can compute temperature by measuring the brightness of the light.

Courtesy Georgia Tech

Emory University medical student Kathryn Rappaport uses the Remotoscope on Aaron Lam, 8.

Using this concept, the Fraden Corp. infrared thermometer accurately measures body temperature without physical contact. An infrared sensor is positioned inside the smart phone next to its digital camera lens. With the phone held close to a patient's temple, the sensor detects when its position is just right and instantly records body temperature. This method not only avoids physical contact but is helpful in preventing potential disease transmission.

The sensor can detect temperatures from –2° F to +400° F, making the device also useful for taking the temperature of inanimate objects and in industrial settings. The IR thermometer can check for possible hazards around automotive and production machinery, chemical processes, energy management, and construction as well as in areas near cooking and refrigeration appliances, a baby's bathwater, or science classroom.

The company has received a U.S. patent for the device and says the technology may lead to a night-vision camera. ■

– Karen Thomas, SPIE staff

Innovation in health, wellness

Progress in technology and consumer demand is driving innovation in the development of smart phone applications.

As this innovation continues, health and wellness will be among the beneficiaries.

Eye contact

Device helps visually impaired recognize non-verbal communication.

The Sett system works by capturing and detecting the position of a person's eyes in the blind person's "line of sight" (left) and converting the information to a tactile signal in a feedback bracelet (right). Center image shows integration of a camera in sunglasses' frame.

For some, the essence of sight is not in the beauty of images but in social inclusion.

Blindness and other visual impairment can complicate social integration, orientation, and communication. In conversations, for instance, it is difficult to establish eye contact or recognize another's meaning and intentions without being able to observe facial expressions and gestures. Similarly, blind people often cannot judge the meaning of silence and other non-verbal cues and are therefore less confident in evaluating emotional behavior.

> "We live in a world in which everything is revealed by light."

Now, researchers in the Netherlands have developed a prototype device for blind and visually impaired people who risk being segregated in society because of their lack of perceptual feedback.

Geert Langereis, an assistant professor at University of Technology (TU/e), and Hugo Christiaans, a graduate student there, used their device in a series of experiments that triggered improved social interactions between a person with total blindness and a seeing interviewer.

In a recent article in the SPIE Newsroom, Langereis and Christiaans report on "Sett," their prototype to "extend and support the other senses and to improve quality of life for the blind."

Sett (Norwegian for see or seen) captures the gaze of people in the line of 'sight' of a blind person and converts the information into a tactile signal, giving the blind person feedback on whether the other person is looking at him/her.

Their article describes the system which includes a pair of sunglasses with a camera that can detect eye contact, a haptic feedback bracelet, and a unit for signal processing.

The sunglasses are 141 mm long, 140 mm wide, and 6 mm tall and hold an integrated HD camera with a resolution of 1280×720. The HD webcam is directly linked to a computer through a USB connection, and the captured images are directly loaded into the processing program, which reduces the images to 510×340.

A software program for face-recognition uses OpenCV libraries and is written in Java. The small bracelet consists of a small vibration motor controlled by an Arduino Uno microcontroller board.

When the camera detects eye contact from another person, the wearer is notified by a vibrating signal in the bracelet.

"We live in a world in which everything is revealed by light," the researchers say, "and so visual impairment and blindness severely impact daily life.

"Globally, it is estimated that 38 million people are blind and more than 110 million people have low vision and are at high risk of blindness," they state. "Cutting off or segregating these people from society often forces the visually impaired into a dependent role that can influence their behavior."

For more information on the device, visit the SPIE Newsroom at: spie.org/news-sett.

The Sett system consists of a camera integrated into a pair of sunglasses and a haptic bracelet.

Solar Decathlon Europe

Photonics For a Better World

Tree canopy functions inspire winning home design.

The two-week Solar Decathlon Europe took center stage in Madrid, Spain, last September as more than 220,000 visitors toured the Solar Village in Casa de Campo Park to see 18 solar-powered homes. The homes were built by teams of university students from 11 different countries throughout Europe and Asia.

Activities designed to educate the public about the responsible use of renewable energy included cooking with photons and pedaling stationary bikes to create energy for a live music show.

Each home earned points in 10 categories ranging from form to function: architecture; engineering and construction; energy efficiency; electrical energy balance; comfort conditions; functioning of the house; communication and raising social awareness; industrialization and market viability; innovation; and sustainability.

After a close competition, French team Rhône-Alpes won with its "Canopea House," engineered to be stacked into "nanotowers" for sustainable urban housing in alpine areas.

Second place went to Team Andalucía of Spain for "Patio 2.12," which consisted of four separate prefabricated modules built on a block for easy removal without leaving a footprint.

Team Rome (Italy) won third place for its sustainable Mediterranean-style house, "Med in Italy."

Among the eclectic entries in the competition were Team Portugal's "cem' casas em movimento," which rotated up to 180 degrees to follow the sun and regulate interior temperatures while producing 2.5 times more energy than it used. Team (e)co of Spain's house mimicked a hermit crab and included a biodegradable interior and exterior greenhouse.

The "Ekó House" from Team Brazil was inspired by the country's indigenous Tupi-Gurani people and featured interior wetlands for gray water treatment, a series of verandas for controlling temperature, and dry composting toilets to minimize waste.

The main objective of the Solar Decathlon is to promote energy-saving technology and raise awareness among the public about the need for sustainable energy, according to Sergio Vega, Solar Decathlon Europe director. In keeping with the idea of sustainability, the Solar Village was connected to a smart grid powered by the energy produced by the participating solar houses.

The Rhône-Alpes Canopea

Team Rhône-Alpes built one prototype of the Canopea for the Solar Decathlon. The complete design would consist of stacks of Canopea homes forming a healthy green habitat in densely populated areas. The prototype was a 75-square-meter unit with a master bedroom, bathroom, and living room with large bay windows that open to an outdoor garden.

Louvers in the interior permit natural ventilation and lighting. The ceilings are composed of earth-radiant panels that can incorporate light strips for interior illumination.

The idea for Canopea House came from tree

The Solar Village in Madrid hosted 18 solar-powered homes in September.

China to host Decathlon in August

The most recent addition to the international family of Solar Decathlon competitions, Solar Decathlon China, is the result of a 2011 agreement between the United States and the People's Republic of China to foster sustainable economic and social development.

Twenty-three teams representing 36 universities from around the world will participate in the Solar Decathlon China 2013 in Datong, China, in August.

Organized by Peking University, Solar Decathlon China 2013 is co-hosted by the China National Energy Administration and the U.S. Department of Energy.

For more information: www.sdchina.org

canopies which absorb about 95% of a forest's overall solar energy and capture almost 30% of rainfall. The design from Rhône-Alpes features individual living spaces stacked to create a nanotower. Clusters of nanotowers are linked by passageways containing areas for gardening, storage, and recycling. An outdoor terrace helps expand the interior space. The top floor is designed to be shared by the community for recreation and other activities such as cooking and doing laundry.

The roof of the Canopea is composed of an array of silkscreened bi-glass photovoltaic panels. The PV array can't generate enough energy to power an entire nanotower but comes close, reducing how much power is needed. Each nanotower is connected to a smart grid that manages heating and cooling systems to optimize energy conservation.

Designed in response to the lack of living space in crowded cities, Canopea houses can be stacked vertically or horizontally to create the nanotowers.

Three Solar Decathlons

First organized by the U.S. Department of Energy in 2002, the Solar Decathlon is an international competition created to allow university students from around the world to design, build, and operate solar-powered housing that focuses on maximum energy efficiency while being cost-effective and attractive. Open to the public, this competition gives visitors the opportunity to tour each house, learn about energy-saving features, and find ideas to use in their own homes.

Since the first Solar Decathlon in Washington, DC, the competition has expanded to include the Solar Decathlon Europe and Solar Decathlon China. The North American edition takes place in odd years and the European version occurs in even years.

The next Solar Decathlon Europe will be held in France in 2014. More information: www.sdeurope.org.

–Karen Thomas, SPIE staff

Read more articles and blog posts celebrating the many ways that photonics are applied in creating a better world:

- spie.org/betterworld
- PhotonicsforaBetterWorld.org

Illustration of how a "Canopea House" would fit into an urban environment.

The winning Canopea House from Team Rhône-Alpes was a prototype of the top two levels of a tower: one home and the common space above.

USA Decathlon October 2013

The U.S. Department of Energy 2013 Solar Decathlon will take place 3-13 October at Orange County Great Park in Irvine, CA.

Since its conception in 2002, the Solar Decathlon has involved 112 collegiate teams pursuing a multidisciplinary approach to building energy-efficient, solar-powered homes.

Twenty participants this year will include teams from the United States, Canada, Mexico, Czech Republic, and Austria.

The solar homes will be open to visitors daily.

Read more about the 2010 Solar Decathlon in the SPIE Newsroom: spie.org/solar2010

Year of Light

Planning has begun for an International Year of Light in 2015.

An international effort to recognize optics and photonics technologies through an "International Year of Light" in 2015 is moving forward after receiving enthusiastic support from the UNESCO Executive Board in October.

Although a final declaration by the UN General Assembly is still needed, UNESCO's approval of a resolution in favor of the IYOL initiative paves the way for a large-scale public awareness campaign about the essential role light-based technologies play in driving industry and enhancing life.

"The science and technology of light have revolutionized medicine, have opened up international communication via the Internet, and are central to linking cultural, economic and political aspects of global society," SPIE Fellow Paul Buah-Bassuah of Ghana's Laser and Fibre Optics Centre at University of Cape Coast told the UNESCO board.

"Advances in light science and technology are crucial for sustainable development, preserving cultural heritage, and addressing climate change," he said.

SPIE and more than 40 scientific societies and institutions, under the leadership of the European and African Physical Societies, have been pushing for the IYOL initiative since 2009.

If approved, a steering committee will coordinate educational and promotional activities during 2015 to show how light plays a central role in science, education, culture, and in improving the quality of life in developing world and in emerging economies.

SPIE support key to success

European Physical Society (EPS) President-Elect John Dudley, an SPIE member and professor at Université de Franche-Comté, is secretary of the IYOL Steering Committee. SPIE Member Angela Guzman of Florida Atlantic University (USA) and SPIE Fellow Chris Dainty from National University of Ireland also serve on the steering committee.

Dudley said SPIE's level of involvement and support in advancing the initiative were essential to garnering support from UNESCO.

SPIE Executive Director Eugene Arthurs serves on the international advisory board for the IYOL Steering Committee along with 2012 SPIE President Eustace Dereniak of University of Arizona (USA), 2011 SPIE President Katarina Svanberg of Lund University Hospital (Sweden), and SPIE Fellow Maria Calvo of Universidad Complutense de Madrid (Spain).

Photo courtesy of Brian Lula

The rainbow will be the symbol for the International Year of Light.

Dudley said that the 2015 International Year of Light program would go beyond the 2010 Laserfest events that celebrated the 50th anniversary of the laser. One of the key goals of the IYOL, he said, is to address the fact that despite the widespread influence of these essential technologies, they remain little understood or appreciated outside of the photonics field.

Optical solutions to problems

"Through this action, UNESCO has joined in advocacy of the profound importance of light in every facet of life," Arthurs said. SPIE is continually working to raise awareness of photonics technology, he noted, especially the many high-value jobs it creates and its numerous applications that have — and will — solve pressing problems in vital areas such as food and water source management, communications, and healthcare.

As examples Arthurs cited inexpensive solar-powered solid-state lighting that has replaced toxic kerosene lamps for indoor use in some developing regions and remote-sensing instruments that can track crop health, major storms, and underground water sources from space.

"Industries based on light are major economic drivers; they create jobs, and provide solutions to global challenges in energy, education, agriculture, and health," the EPS said. ■

Four themes for 2015 Year of Light

The International Year of Light will focus on four themes for outreach and educational activities.

"Science of Light" activities will show how studying the fundamental scientific properties of light impacts widely on all fields of science, technology, and engineering.

"Tools for the Future" will highlight examples of light as an enabling technology in medicine, communications, and energy. This theme will also highlight exciting emerging applications in the study and preservation of cultural heritage.

"Light for Development" will promote low-carbon-emission lighting such as those using solar power for environmental sustainability and improving the quality of life in the developing world. This theme will also stress the need for applying modern photonic devices to applications such as agriculture, disease prevention, and water purification.

The "Pioneers of Light" theme will draw attention to the human stories and contributions that have been made by virtually every major figure in science.

Photonics Initiative

SPIE wants your input and help to create a national photonics initiative.

The 2012 report, "Optics and Photonics, Essential Technologies for Our Nation," has already generated attention from the U.S. government and action from SPIE and other scientific societies interested in seeing its recommendations adopted. And more activities are being planned throughout this year.

The U.S. National Research Council report emphasizes optics' role as an enabling technology and underscores its importance to the U.S. and global economy. It focuses specifically on opportunities for optics and photonics in communications, defense and national security, energy, health and medicine, advanced manufacturing, advanced photonics measurements, strategic materials for optics, and displays.

One of the report's key recommendations is the creation of a National Photonics Initiative (NPI) to bring together academia, industry, and government entities in the United States to steer federal R&D funding and activities. SPIE is working with the American Physical Society, the Optical Society of America, the IEEE Photonics Society, the Laser Institute of America, and other societies to begin building the framework of the NPI, with the hope of fostering collaboration and coordination among different stakeholders.

Calling on legislators

An NPI would establish a network of representatives from industry, academia, national labs, and federal agencies to identify and advance areas of photonics that are critical for maintaining U.S. competitiveness and national security, and to ensure that policymakers implement recommendations from the report.

SPIE has played a leading role in bringing attention to the report and the need for action to meet its "grand challenges." On 12 September, for instance, SPIE Executive Director Eugene Arthurs was a lead presenter at a briefing for Congress in Washington, D.C., focusing on the role of optical science in solving problems, enabling innovation, facilitating economic growth, and improving lives. Participants encouraged policymakers to take action to support emerging optical technologies and current capabilities.

Earlier in the day, U.S. Secretary of Energy Steven Chu and former Intel CEO Craig Barrett briefed federal agencies on the report.

Other events in which SPIE has participated to publicize optics and photonics as essential technologies were held in the fall in New York, Arizona, California, and at several international venues, including a Photonics21 meeting in Brussels.

U.S. Secretary of Energy Steven Chu (left) with SPIE Executive Director Eugene Arthurs

Taking the 'essential' survey

To help engage industry in these efforts, SPIE is creating several forums for optics and photonics professionals to provide input that will be communicated to the U.S. government.

In addition to conducting an online survey, SPIE is sponsoring an event at SPIE Photonics West 7 February where Arthurs will give a keynote talk about the NPI and growth opportunities in the photonics industry.

All attendees at Photonics West are invited to Arthurs' talk at 8:45 a.m. Thursday, 7 February, at the Moscone Center in San Francisco.

To give your feedback on the NPI, take our survey. Go to ow.ly/fCYRk or scan the code below.

To learn more about the 2012 report, see the President's Letter on page 4 or go to opticsandphotonics.org. ■

–Alison Jones, SPIE staff

Take the survey about the National Photonics Initiative.

Challenges for optics

In addition to assessing the current state of optics, photonics, and optical engineering in the United States, the National Research Council report, "Optics and Photonics, Essential Technologies for Our Nation," highlights the "grand challenges" in the field and recommends actions to ensure that these challenges are met.

These challenges include:

- Inventing technologies for increased capacity (factor-of-100) in optical networks
- Developing a seamless integration of photonics and electronics components as a mainstream platform for low-cost fabrication and packaging of systems on a chip
- Developing military platforms capable of wide-area surveillance, exquisite-object identification, high-bandwidth free-space communication, laser strike, and defense against missiles
- Achieving cost parity across the nation's electricity grid by 2020 for solar power versus new fossil-fuel-powered electric plants
- Developing optical sources and imaging tools to support an order-of-magnitude increase in resolution in manufacturing.

2013 SPIE Leadership

The following officers and directors will serve as SPIE's leaders in 2013. Contact anyone listed here through Bobbie Lively, SPIE director of executive and administrative services, at bobbie@spie.org. For more information, go to spie.org/leadership.

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Kathleen Richardson
University of Central Florida (USA)

D. P. Tsai
National Taiwan University (Taiwan)

Lisa M. Tsufura
Marketing and Business Strategist

New Books from SPIE

Spectral Computed Tomography
Björn J. Heismann, Bernhard T. Schmidt, Thomas Flohr
Vol. PM226

Modeling the Optical and Visual Performance of the Human Eye
Pier Giorgio Gobbi
Vol. PM225

Introduction to Semiconductor Manufacturing Technology, *Second Edition*
Hong Xiao
Vol. PM220

Sensor and Data Fusion: A Tool for Information Assessment and Decision Making, *Second Edition*
Lawrence A. Klein
Vol. PM222

Field Guide to Optomechanical Design and Analysis
Katie Schwertz, Jim Burge
Vol. FG26

Field Guide to Terahertz Sources, Detectors, and Optics
Créidhe O'Sullivan, J. Anthony Murphy
Vol. FG28

Optical Scattering: Measurements and Analysis, *Third Edition*
John C. Stover
Vol. PM224

Integrated Optomechanical Analysis, *Second Edition*
Keith B. Doyle, Victor L. Genberg, Gregory J. Michels
Vol. PM223

High Dynamic Range Imaging: Sensors and Architectures
Arnaud Darmont
Vol. PM214

Field Guide to Lens Design
Julie Bentley, Craig Olson
Vol. FG27

Value Metrics for Better Lighting
Mark S. Rea
Vol. PM228

Maxwell's Equations of Electrodynamics: An Explanation
David W. Ball
Vol. PM232

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www.spie.org/newtitles

Meet your new SPIE president

Bill Arnold is chief scientist and a vice president at ASML USA.

Bill Arnold, the 2013 SPIE president, is the chief scientist and vice president of the ASML Technology Development Center, responsible for ASML's global technology development efforts in microlithographic exposure tools. Currently working in Arizona (USA), he has also worked at ASML's Netherlands headquarters and frequently travels to California, Taiwan, and elsewhere in his lead role as R&D and IP manager for the world's largest lithography equipment manufacturer.

He became an SPIE Fellow in 2004 in recognition of his work in optical lithography in support of semiconductor production.

Before joining ASML in 1998, Arnold, 58, worked for 18 years at Advanced Micro Devices in California where he was a senior fellow. He received his BA in physics from Hampshire College (USA) and an MS in physics from University of Chicago.

His service to SPIE includes four years as chairman of the SPIE Publications Committee and numerous roles with SPIE Advanced Lithography, including chair and vice chair of what was called SPIE Microlithography in the 1990s. At the 1995 symposium, he invited Intel co-founder Gordon Moore to give a plenary talk on lithography and the future of Moore's Law.

Arnold, who wrote about Moore's Law and the future of EUV lithography for *SPIE Professional* in 2008, is scheduled to give a keynote talk at SPIE Advanced Lithography in February on metrology in times of shrinking budgets.

We asked Arnold to discuss his career path, education, and other interests with the members of SPIE.

Tell us a little bit about where you grew up, your family, and your hobbies and interests.

I grew up in various places in the eastern United States and Midwest. My dad was a nuclear engineer working for Westinghouse, and we moved several times when I was young. However, I spent most of my time in elementary school and high school in Pittsburgh, PA, and summers in Holland, MI. I like to be active and I travel a lot with my wife, Jane. I fill my passport with a lot of stamps and have to get extra pages. I am a long-time bookworm with a big library but in recent years I carry a Kindle on travel. I love dogs and take my three best friends for long walks in the Arizona desert when the weather is nice in the winter and on the beach at Lake Michigan in the summer. Like most lithographers, I like to take pictures. Also, I paint a picture or two a year, though I am not much of an artist.

How and when did you first get interested in a career in science and solving technical problems?

I went to a great engineering high school in Baltimore, MD, for 2 ½ years, Baltimore Polytechnic. I learned a lot of math and mechanical drawing, which served me well in my career.

Later in college, I had an inspiring physics professor who introduced me to quantum mechanics and the writings of Richard Feynman, including his classic talk, "There's Plenty of Room at the Bottom," which described the incredible horizons and future of shrinking objects and devices to the microscopic and below. Everyone should read that article.

What led you into the semiconductor industry?

I moved to California with Jane in 1979 and looked for a job through the student help service at University of California, Berkeley, where she had received her undergraduate degree. One of those companies where I interviewed was Advanced Micro Devices (AMD), run by the Silicon Valley legend Jerry Sanders.

Because I had studied optics at the University of Chicago, AMD offered me a job as a photolithographer, which, at that time, was not taught in any school.

I inherited a wafer stepper, the key tool of silicon fabrication,

SPIE President Bill Arnold, 6th from right, with SPIE Board members and staff in Sweden last October. The group toured the building where Johannes Rydberg worked and proposed the Rydberg formula for the wavelength of light emitted from the hydrogen atom.

Moore's Law: Gordon Moore predicted in 1965 that the density of silicon transistors on a chip would double every 12 months. He amended his prediction in 1975 to say the density would double every 18 months.

but at that time no one knew what it was good for. It was an orphan, as the previous engineer who owned it had quit.

Times being what they were in the depths of a recession, I took the job. I had no idea how to make the stepper work nor did anyone else at AMD. They handed me the manuals on my first day and said, "This is yours; make some wafers with it." That was the biggest break of my career.

How and when did you first get involved with SPIE?

In photolithography in the early 1980s there was only one meeting a year of any real merit and luckily for me, it was only a five-minute drive from where I worked in Sunnyvale, CA. This was the SPIE Optical Lithography Conference, then held in Santa Clara. I think my first meeting was in 1982.

I met some of the greats in my field at that meeting including Burn Lin and Grant Willson. I started writing papers on what I was doing with wafer steppers starting in 1983. Burn Lin asked me to be a session chair a few years later, and I was hooked into service.

Can you discuss your role in strategic planning with ASML?

I joined ASML as its chief scientist in 1998 and have been involved in the long-range planning of our products since I started. We have a rigorous process which combines excellent field marketing with world-class research and development to decide what types of tools must be built to fabricate the semiconductor devices of three to five years in the future.

Since I made chips in my early career, my best contributions have been in forecasting what will be needed next by our customers.

What kinds of career opportunities are there in lithography?

Lithography is a field which needs people in many specialties to work together to make the chip, or in my case, the tool that makes the chip. Physicists, chemists, chemical engineers, computer scientists, optical engineers, and people in many other disciplines can all find a great career in this field.

What kinds of traits, skills, education, and experiences do you look for in a new employee?

Basic math, science, and computer skills are the threshold requirements. A background in optics is always good! I like people who can do an experiment or build things themselves. Most important is the ability to work well with other people as lithography and semiconductor fabrication is a team effort. ■

Photonics21 April meeting

Photonics21 will hold its annual meeting 29-30 April in Brussels.

For more information, www.photonics21.org.

Jenoptik's Mertin takes leadership role at Europe tech platform Photonics21

Michael Mertin, president of SPIE corporate member Jenoptik (Germany) since 2007, is the new president of the European technology platform Photonics21 and will lead the optics and photonics community during a new phase of Europe's research and innovation funding program.

Mertin was elected to the position by the Photonics21 Board of Stakeholders in November. He pledged to gain and defend a competitive position for optics and photonics under the European Commission's Horizon 2020 program, the €80 billion R&D funding program which takes effect in 2014.

A study by the European Commission found that 20-30% of European businesses rely on photonics in everyday areas like energy-efficient lighting, laser-material processing, medical diagnostics, and communication and sensing technologies.

SPIE 2012 President Eustace Dereniak congratulated Mertin and commended him for his active engagement with SPIE and his experience as a visionary leader.

Mertin "has a strong understanding of the importance of the industry-academia collaborations through which new technologies become applications that result in creative solutions to problems across every area of life," Dereniak says.

Mertin's successes at Jenoptik and comprehensive knowledge of and experience in business administration make him "an excellent choice to coordinate the diverse elements of the European photonics industry in the role of president of Photonics21," adds SPIE Executive Director Eugene Arthurs.

The 46-year-old expert on lasers, leadership, and business strategy has been active with Photonics21 for several years and serves on the board of the German high-tech industry association Spectaris. He is a member of the federal and Thuringian executive committees of the German Council of Economic Advisors and chairman of the Board of Trustees of the Fraunhofer-Institute für Angewandte Optik und Feinmechanik (IOF) in Jena.

His work with all aspects of Jenoptik's business has boosted the company's success. Currently employing 3100 staff around the world, Jenoptik is also the lead sponsor of the SPIE Startup Challenge, a business-pitch competition at SPIE Photonics West that awards cash prizes as well as business development training.

Photonics21 is an industry-driven program to unify and advance the optical technologies community in Europe. Established in December 2005, its successes include the naming of photonics as one of five "key enabling technologies" by the EC in 2009.

Mertin, who succeeds Martin Goetzeler of Osram, noted that with Europe's economic crisis, it is "crucial" to ensure that every euro in the Horizon 2020 program is spent wisely.

"Photonics21 will support this endeavor through the establishment of a Public-Private-Partnership and an industry pledge to a four-fold leverage of public funding," he told the Board of Stakeholders. "This future PPP is the expression of our full commitment to pursue cooperation between private and public sectors and the perfect instrument to strengthen Europe's innovation capacity."

Mertin studied physics at the RWTH Aachen and received his doctorate in engineering from the Fraunhofer-Institut für Lasertechnik (FHG-ILT) in the field of laser materials processing and surface technology.

Mertin previously worked for Carl Zeiss in Oberkochen as head of Technology and Coating. After a merger that resulted in the founding of Carl Zeiss Vision International, he became vice president of Technology and Processes. ■

Eugene Arthurs (left) congratulates Jenoptik President and CEO Michael Mertin on his election as president of Photonics21.

SPIE Europe E-News

To subscribe to the quarterly SPIE Europe E-News and other updates from SPIE, go to: spie.org/newsEUQ

2013 Events

SPIE
Connecting minds. Advancing light.

North America

Photonics West
2–7 February 2013
Exhibition Dates:
BiOS Expo: 2–3 February 2013
Photonics West: 5–7 February 2013
San Francisco, California, USA

IS&T / SPIE Electronic Imaging
SCIENCE AND TECHNOLOGY
3–7 February 2013
Burlingame, California, USA

Medical Imaging
9–14 February 2013
Lake Buena Vista, Florida, USA

Advanced Lithography
24–28 February 2013
Exhibition Dates:
26–27 February 2013
San Jose, California, USA

Smart Structures/NDE
10–14 March 2013
Exhibition Dates:
12–13 March 2013
San Diego, California, USA

Defense Security+Sensing
29 April to 3 May 2013
Exhibition Dates:
30 April–2 May 2013
Baltimore, Maryland, USA

Optics+ Photonics
25–29 August 2013
Exhibition Dates:
26–28 August 2013
San Diego, California, USA

Photomask Technology
10–12 September 2013
Exhibition Dates:
10–11 September 2013
Monterey, California, USA

Laser Damage
22–25 September 2013
Boulder, Colorado, USA

Optifab
14–17 October
Exhibition Dates:
15–17 October 2013
Rochester, New York, USA

Europe

Optics+ Optoelectronics
15–18 April 2013
Exhibition Dates:
16–17 April 2013
Prague, Czech Republic

Microtechnologies
24-26 April 2013
Grenoble, France

Optical Metrology
13–16 May 2013
Munich, Germany

Remote Sensing
23–26 September 2013
Dresden, Germany

Security+ Defence
23–26 September 2013
Exhibition Dates:
24–25 September 2013
Dresden, Germany

Asia-Pacific

Nano-Bio Sensing Imaging+Spectroscopy
20–23 February 2013
Jeju Island, Republic of Korea

SeTBio
Sensing Technologies for Biomaterial, Food, and Agriculture
23–26 April 2013
Yokohama, Japan

SPIE / SIOM Pacific-Rim Laser Damage
19–22 May 2013
Shanghai, P. R. China

Smart Nano-Micro Materials+Devices
December 2013
Melbourne, Australia

www.spie.org
+1 360 676 3290
help@spie.org

Events for members only

- **SPIE Fellows luncheon**
  12 pm, 4 February

  Joshua Silver of the Centre for Vision in the Developing World (UK) discusses, "How to Deliver Vision Correction to the World: A Disruptive Approach." RSVP required. Contact Brent Johnson at brent@spie.org.

- **SPIE Senior Member breakfast**
  8 am, 5 February

  RSVP required. Contact Brent Johnson at brent@spie.org.

- **SPIE member reception**
  8 pm, 5 February

  Cityscape Room, top of the Hilton San Francisco Union Square Hotel.

Prism Awards at Photonics West

The 2013 Prism Awards for Photonics Innovation will be presented by SPIE and Photonics Media on 6 February at SPIE Photonics West at a banquet and ceremony recognizing innovative products, processes, devices, systems, instruments, and technologies that are newly available on the open market.

Finalists for each category were announced in November.

See page 5 or PrismAwards.org for a list of finalists.

The GREENING of Photonics West

Annual event is 2–7 February in San Francisco

Innovative research in photonics for green energy sources, efficient lighting, laser-assisted manufacturing, and computing will be showcased at SPIE Photonics West, 2-7 February at the Moscone Center in San Francisco (USA).

SPIE Photonics West 2013 will also present the latest in light-driven technologies from biomedical diagnostics to developments in efficient high-power lasers. More than 20,000 attendees are expected at this international event, which will feature some 4500 papers and presentations on photonics, laser, microfluidics, and biomedical optics research and technology.

The SPIE Photonics West Exhibition and BiOS Expo will host nearly 1300 companies displaying the latest products, applications, and innovations.

Industry panel on sustainability

Two special events at Photonics West 2013 highlight green photonics — the use of photonics in environmental and energy-related applications.

The SPIE Green Photonics Virtual Symposium, chaired by SPIE Fellow Stephen Eglash of the Precourt Institute for Energy at Stanford University (USA), includes more than 65 papers in renewable energy, lighting, displays, manufacturing, and communications. These papers will be presented throughout the conference, and awards will be given to the best.


Eglash

Eglash will also lead a panel discussion, "Emerging Growth Opportunities in Sustainable Technology," with five leading industry executives discussing new technologies that could potentially reduce energy consumption and offer alternative energy sources within the next five to 10 years.

"When we say, 'green photonics,' we're really talking about sustainability," Eglash says. "We're talking about industries that relate to a more efficient use of natural resources and energy and all the technologies that help us to use energy and resources more efficiently in our businesses and in our daily lives.

"It's about helping the planet," he says, "but also about creating profitable and sustainable businesses in the long run."

> The green photonics market has been expanding as industries discover photonics technologies provide green, efficient solutions that can offer a competitive advantage.

Green and clean technologies

Panel members represent a diverse group of individuals with experience in research and development of sustainable technologies.

Patricia Glaza of Arsenal Venture Partners (USA) works closely with government agencies, multinational corporations, and startups to identify and promote technology solutions in energy, water, and overall sustainability.


Glaza

"The shine of being 'green' has lost some luster as economic concerns have slowed environmental and sustainability momentum," Glaza says. "My goal is that panel participants walk away from this session understanding that these objectives are not mutually exclusive. The reduction of energy consumption translates directly to increased competitiveness."

As an example of how green, efficient solutions can offer a competitive advantage, Glaza notes that one data center can consume the energy of a medium-sized city. However, "green photonics can reduce this growing load both directly and indirectly," she says, with switches, cables, and data storage as well as lights and power used to run the facility.


Silverthorn

Panelist Lesley Silverthorn, CEO of Angaza Design (USA), will talk about how her company combines technology innovation with a novel business model to bring LED lights, solar panels, and batteries to some of the poorest people on the planet.

"A variety of new clean-tech solutions are being developed that are targeted at the quarter of the world's population that does not have access to a reliable source of power," says Silverthorn, whose background blends human-centered design with mechanical engineering skills.

"However, it takes innovation on the delivery and financing of these solutions to ensure they are effectively adopted," she says. "I plan to discuss

effective, scalable clean-tech payment models that enable these customers to purchase alternative energy in small amounts as they use it."


Crosson

Eric Crosson, CTO of Picarro (USA) will discuss how spectroscopic instruments for environmental monitoring are allowing all parts of society to become involved with green energy practices.

"Where unwanted emissions are concerned, hide and seek is over," Crosson says. "New developments in green photonics are enabling regulators, politicians, service firms, NGOs, city managers, sustainability officers, and even citizens to visualize and quantify emissions as never before possible.

"This is a huge paradigm shift for companies which are, to date, unconcerned with their emissions because of the unwritten 'don't-ask, don't-tell policies' of today. With the advent of green photonics, everyone will know," he says.

Other panelists discussing growth opportunities in photovoltaics, solid-state lighting and displays, laser-assisted manufacturing, micro- and nanofabrication, and renewable-energy generation are:


Baer

- Thomas Baer, executive director of the Photonics Research Center at Stanford University (USA). Baer is considered a pioneer in biotechnology, laser development, and laser applications and has been extensively involved with startup companies such as Auxogyn, Arcturus Bioscience, Biometric Imaging, and Spectra-Physics.


Bhardwaj

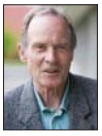
- Jyoti Bhardwaj, head of technology R&D at Philips Lighting Lumileds (USA). He has held senior management positions at JDSU (USA), a provider of test and measurement solutions for the communications industry, and was CEO of Scion Photonics (USA), an optical-chip startup.

BiOS highlights

BiOS, the world's largest and most influential biomedical optics and biophotonics symposium, kicks off Photonics West on Saturday, 2 February. BiOS conferences cover such topics as photonic therapeutics and diagnostics; tissue optics, laser-tissue interaction, tissue engineering; biomedical spectroscopy, microscopy, imaging, and nano/biophotonics.

New conferences in optogenetics, hybrid-optical control of cells, and terahertz and ultrashort electromagnetic pulses for biomedical applications reflect advances and growing interest in personalized medicine.

Saturday night, BiOS attendees can hear more on the very latest biomedical advances in the popular BiOS Hot Topics session facilitated by SPIE Member Sergio Fantini of Tufts University (USA). Speakers and topics include:


Bamberg


Potsaid


Oron


Sorger


Choi


Fink


Culver


Zharov

- Ernst Bamberg of Max Planck Institute für Biophysik (Germany), "Optogenetics and Hybrid-Optical Control of Cells"
- Ben Potsaid of Massachusetts Institute of Technology (USA), "MEMs Tunable VCSEL Technology for Ultrahigh-Speed OCT"
- Dan Oron of Weizmann Institute of Science (Israel), "Patterned Multiphoton Photoactivation in Scattering Tissue by Temporal Focusing"
- Jonathan Sorger of Intuitive Surgical (USA), "Clinical Requirements for Optical Imaging in Medical Robotics"
- SPIE Member Bernard Choi of Beckman Laser Institute (USA), "Camera-Based Functional Imaging of Tissue Hemodynamics"
- Mathias Fink of Institute ESPCI, CNRS (France), "Multiwave Approach to Elasticity Imaging for Cancer Detection"
- Joe Culver of Washington University in St. Louis (USA), "Functional Optical Imaging of the Brain"
- SPIE Member Vladimir Zharov of University of Arkansas for Medical Sciences (USA), "Photoacoustic Flow Cytometry: Journey in the Blood"


Fujimoto


Anderson

SPIE Fellows and long-time BiOS chairs James Fujimoto of Massachusetts Institute of Technology (USA) and R. Rox Anderson, director of the Wellman Center for Photomedicine at Massachusetts General Hospital (USA), once again chair this symposium.

LASE highlights

"Energy-efficient processes are becoming increasingly important for industrial production," says SPIE Fellow and

Continued on page 42 ▶

Job seeking?

Whether you're looking for your first job, re-entering the workforce, or looking for a better workplace, plan to attend a professional development event and/or the Job Fair at Photonics West in San Francisco 5-6 February.

Admission to the Job Fair is free to those with technical conference or exhibition badges for Photonics West, and all services through the SPIE Career Center are free to individuals seeking employment.

Recruiters from top optics and photonics companies will be available to discuss current and future job openings onsite at the Moscone Center.

A professional development speakers' series will be held on Sunday 3 February. This series is designed for students and early career professionals, but all are welcome to attend and explore topics in innovations and entrepreneurship.

Can't make it to Photonics West Job Fair in person? Go online to post your resume at spie.org/careercenter

Connect @PhotonicsWest in San Francisco

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- Tweet with us with @PhotonicsWest and @SPIETweets
- Follow daily news updates at spie.org/news or through the new "show daily" publication which will be distributed to all exhibition attendees Tuesday through Thursday.
- Share comments and photos on Facebook at Facebook.com/SPIE.org
- Create your daily schedule of conferences, courses, and special events with the SPIE conference app for mobile devices at spie.org/mobile
- To register, go to spie.org/pw

The Greening of Photonics West

◀ Continued from page 41

LASE symposium chair Andreas Tünnermann of Fraunhofer-IOF (Germany).


Tünnermann

Because laser technology has already proven necessary in enabling green manufacturing processes, LASE conferences will cover the latest developments in high-power lasers and advanced laser-material processing. LASE conferences will also feature fiber, disk, and ultrafast lasers plus the world's largest concentration of semiconductor laser/LED content.

SPIE Fellow and consultant Bo Gu (China) will also serve as symposium chair. Co-chairs are SPIE member Friedhelm Dorsch of TRUMPF (Germany) and SPIE Fellow Alberto Piqué of the U.S Naval Research Lab (USA).


Gu


Dorsch


Piqué

LASE Plenary speakers are:

- Wim Leemans from Lawrence Berkeley National Lab (USA), "Laser-Based Particle Acceleration and the Path to TeV Physics and Compact X-ray and Gamma Ray Sources"
- Martin Wegener of Karlsruhe Institute of Technology (Germany), "Three-Dimensional Metamaterials Made by Direct Laser Writing"
- Geert Verhaeghe of Faurecia Autositze (Germany), "Remote Laser Welding for Automotive Seat Production."


Leemans


Wegener


Verhaeghe

OPTO highlights

Attendees of OPTO will see the latest advances in silicon photonics, photonic crystals, optoelectronics, semiconductor lasers, quantum dots, and nanophotonics research.

"The OPTO symposium continues to grow in size and impact, and this year's meeting is shaping up to be particularly exciting," says SPIE Fellow and OPTO chair David L. Andrews of University of East Anglia Norwich (UK). "Conferences in six tracks will cover the latest developments in optical materials and devices, as well as research innovations where the interplay of experiment with theory and simulation is especially rich.


Andrews

"Some of the most eagerly anticipated news will be on the latest advances in quantum applications, including quantum memories, quantum optomechanics, and quantum optical vortices," Andrews says.


Glebov


Streubel

OPTO symposium co-chairs are SPIE Fellow Alexei L. Glebov of OptiGrate Corp. (USA) and SPIE member Klaus P. Streubel of OSRAM AG (Germany).

OPTO plenary speakers are:

- Markus Aspelmeyer of the Vienna Center for Quantum Science and Technology, University of Vienna, "Quantum Optomechanics"
- Richard Soref of University of Massachusetts-Boston, "Group IV Photonics for the Mid Infrared"
- SPIE Fellow Miles J. Padgett of University of Glasgow, "Light in a Twist: Optical Angular Momentum"


Aspelmeyer


Soref


Padgett

MOEMS-MEMS highlights

Seven MOEMS-MEMS conferences focusing on R&D topics in micro- and nanofabrication, devices, reliability and emerging applications will give a comprehensive overview of MOEMS-MEMS current topics of interest.

"This symposium, in combination with the SPIE Photonics West trade show, is probably the best opportunity worldwide to discuss and learn about novel trends in fabrication, device design, characterization, and innovative applications of MOEMS-MEMS devices," says SPIE member and symposium chair Harald Schenk of Fraunhofer-Institut für Photonische Mikrosysteme (Germany). "Experts from around the world have the opportunity to learn about the latest developments in these fields and network with colleagues."


Schenk


Kaminska


Knobloch


Jiang

MOEMS-MEMS plenary speakers are:

- Bozena Kaminska of Simon Fraser University (Canada), "Towards Future Systems with Nano-Optics Contributions"
- Aaron Knobloch from the GE Global Research (USA), "Optical MEMS Pressure Sensors for Geothermal Well Monitoring"
- Kaili Jiang of Tsinghua University (China), "Super-aligned Carbon Nanotubes: A Road toward Real Applications"

Startup Challenge for next-gen entrepreneurs

The SPIE Startup Challenge, with lead sponsorship from Jenoptik (Germany), is now in its third year and growing in popularity. This lively, interactive pitch competition invites young entrepreneurs to pitch their light-based technology business plan to a team of technology development experts and venture capitalists.

Winners of past competitions have offered business plans for new methods for drug delivery, cancer detection, and macular-pigment measurement.

This year's event has expanded to offer $10,000 for the winning pitch, $5,000 for second place and $2,500 for third place. Each of 10 participants to make the final round will be sponsored to attend the entrepreneurship academy at the University of California, Davis (USA).


Wax

"I think it's a very valuable experience," says SPIE Fellow Adam Wax of Duke University (USA) who served as a judge at the 2012 SPIE Startup Challenge. "There's a very different priority placed on commercialism as compared to academic research. As academics, we almost think it's bad to say 'we want to make money.' But this is the first thing venture capitalists want to hear. How you position your work is essential if you're going to make that kind of connection."

Wax adds, "The Startup Challenge helps set up our next generation of entrepreneurs."

Networking events and special forums

SPIE Photonics West always includes networking opportunities and sessions featuring entrepreneurs and innovation.

Silicon photonics technology may soon revolutionize computing with smaller, cheaper optical interconnects. This year's panel on "Silicon Photonics and Photonic Integrated Circuits" will feature industry experts exploring the latest R&D progress and providing insights on how to leverage this ground-breaking technology.

"The year-to-year popularity of this panel at Photonics West reflects the growing demand for greater speed in the next generation of computing as well as recognition on the part of industry of the need to be in front of the pack in meeting that demand," says SPIE's Peter Hallett, who will moderate the discussion.


Hallett

Stephen G. Anderson, SPIE industry and market strategist, will lead a panel of top executives discussing their perspectives on the world of optics and photonics. Panel members will share insights learned while weathering the economic setbacks of 2011 and 2012.


Anderson

SPIE member Michelle Xu of University of California, Berkeley (USA) will serve as moderator for the SPIE Women in Optics panel discussion, "What Works for You: A Mentoring Panel for Women in Science and Technology."

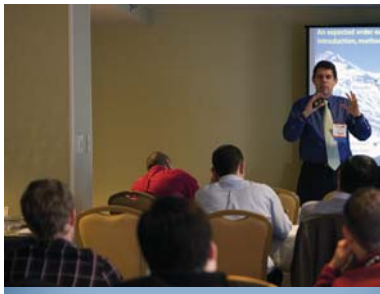

Xu

Open to all conference attendees, this discussion features women who have pursued diverse paths to balance career and family. Round-table sessions with one panelist per table leading the discussion will follow an introductory panel discussion.

SPIE Women in Optics seeks to build mentoring relationships for female graduate students and recent graduates in science, technology, engineering, and mathematics through interaction with those already establishing their careers.

More information on SPIE Photonics West: spie.org/pw. ■

–Karen Thomas, SPIE staff



New courses at Photonics West

Photonics West onsite courses offer an engaging experience for those who prefer face-to-face instruction by some of the best instructors in the industry. Course discounts of up to 50% are offered to SPIE student members.

The 70 technical courses and professional development workshops offered at SPIE Photonics West provide essential background on fundamental topics and emerging technologies that can extend the breadth of your technical knowledge.

New courses have been added, including those covering nanobioengineering and nanomedicine, fiber Bragg gratings, and hands-on multiphoton tomography.

Program tracks include biomedical spectroscopy, microscopy, and imaging; photonic integration; metrology and standards; displays and holography; and laser applications.

Go to spie.org/pwcourse

Lasers at Winter College

The 2013 Winter College on Optics delves into laser applications and development.

Students at the 2013 Winter College on Optics will explore trends in laser development and participate in hands-on sessions covering lab laser safety and methods for using the laser for high-precision measurements and investigation of material properties and radiation-matter interaction.

The theme of the annual event at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, 4-15 February, is "Trends in Laser Development and Multidisciplinary Applications to Science and Industry."

Lectures at the Winter College on Optics will focus on emerging schemes and materials for developing laser sources, including new laser media and laser regimes.

The second half of the course will be dedicated to laser applications such as advanced micromachining with femtosecond laser pulses for the realization of photonic and micro-optofluidic devices with intrinsic 3D capabilities. Instructors will cover the impact of lasers in information and communication technologies, life science, domotics, the environment, energy production security, and related fields, with particular attention paid to technology-transfer issues and industrial applications.

Attendees are encouraged to present their research, with poster prizes sponsored by SPIE and free access to the SPIE Digital Library during the two-week session.

SPIE supports the ICTP Winter College on Optics, along with the International Commission for Optics, OSA, European Optical Society, Società Italiana di Ottica e Fotonica, U.S. National Academy of Science, IEEE Photonics Society, and International Society on Optics Within Life Sciences.

In addition to the Winter College, SPIE provides $30,000 annually to support an optics staff position at an ICTP laboratory pursuing novel research in spectroscopy with quantum cascade lasers, available to participants from developing nations. The lab is housed at the Istituto Nazionale di Fisica Nuclear (INFN) and run in collaboration with the Institute for Nanoelectronics, Technische Universität München.

In conjunction with ICTP, SPIE provides free SPIE Digital Library access in participating countries through the eJDS program.

Directors for the 2013 event are SPIE Fellow Fernando Mendoza Santoyo, general director of Centro de Investigaciones en Optica (Mexico); Roberta Ramponi, professor at Istituto di Fotonica e Nanotecnologie (Italy); and Fredrik Laurell of the KTH Royal Institute of Technology (Sweden.)

Local organizers are Joseph Niemela from the ICTP and Miltcho Danailov of the Elettra-Sincrotrone in Trieste.

For more information: ow.ly/fq9ZH. ■

Talking about optics

Experts in EUV lithography, biomimicry, 3D metamaterials, MEMS sensors, IR detectors, signal processing, optogenetics, patent law, personalized medicine, functional MRI, and other medical imaging technologies are among the top speakers at several SPIE symposia in the first half of the year.

SPIE organizes and sponsors approximately 25 major technical forums, exhibitions, and education programs every year in North America, Europe, Asia, and the South Pacific to advance light-based technologies and foster collaboration among researchers and industry. Most plenary and keynote talks at meetings are free to attendees.

SPIE Photonics West and IS&T/SPIE Electronic Imaging start off the year in early February with nearly 20 plenary talks and numerous keynotes focused on lasers, biophotonics, optoelectronics, advanced imaging systems, nano-optics, and other optics and photonics topics. See pages 40 and 47 for information on speakers at those meetings.

SPIE Medical Imaging, 9-14 February in Lake Buena Vista, Florida (USA), will offer nine keynote talks in addition to a plenary session on volumetric analyses in the interpretation of computed tomography data by Geoffrey Rubin of Duke University Medical Center (USA).

Advanced Lithography

Also in February, SPIE Advanced Lithography 2013 will have three plenary speakers, including Charles Szmanda, a patent attorney from Massachusetts (USA) who works closely with electronics and semiconductor companies. Szmanda will discuss the new U.S. patent law and how it will affect photonics technology businesses.

According to Szmanda, publishing information about an innovative technology or device at the wrong time can destroy an inventor's right to get a patent. However, "publishing at the proper time can enhance your competitive position," he says. Szmanda will also discuss the new first-to-file system which takes effect 16 March. (See more about the new U.S. patent law on page 12.)

Other speakers at SPIE Advanced Lithography, 24-28 February in San Jose, CA (USA), are:

- Bill Siegle, an independent consultant and ASML Advisory Board member (USA)
- Howard Ko, senior vice president and general manager at Synopsys Silicon Engineering Group (USA)

Smart Structures/NDE

SPIE Smart Structures/NDE returns to San Diego, CA (USA) 10-14 March with five plenary speakers and 10 conferences on such topics as robotics systems, electroactive polymer devices, and nondestructive health monitoring of bridges and other civil and military infrastructure.

Larry Stambaugh, managing director of the Centre for Bioinspiration at the San Diego Zoo will give his plenary talk on the zoo being a resource for innovators working in biomimicry technologies. Other plenary speakers at SPIE Smart Structures/NDE are:

- Karlheinz Bock of Fraunhofer Research Institution for Modular Solid State Technologies EMFT (Germany)
- SPIE Fellow Tribikram Kundu of University of Arizona (USA)
- Dimitris Lagoudas of Texas A&M University (USA)
- Eric A. Lindgren of U.S. Air Force Research Lab

Defense Security+Sensing

Arati Prabhakar, director of the U.S. Defense Advanced Research Projects Agency (DARPA) will be symposium wide plenary speaker at SPIE Defense, Security, and Sensing when it returns to Baltimore, MD (USA), at the end of April.

Prabhakar, a former director of the National Institute of Standards and Technology, has worked in private industry and was also the founding director of DARPA's Microelectronics Technology Office.

Letitia Long, director of the U.S. National Geospatial-Intelligence Agency, will be the banquet speaker and receive the symposium's Lifetime Achievement Award.

In addition to plenary talks, the event will have 62 conferences on sensors, detectors, displays, and photonic systems for security, defense, and the environment; a free job fair; three-day exhibition; and 50 courses and workshops for professional development.

SPIE Defense, Security, and Sensing opens 29 April in the Baltimore Convention Center and runs through 3 May. ■

European meetings in April, May

SPIE is organizing three major events in Europe this spring on microtechnologies, optoelectronics, metamaterials, metrology, high-energy lasers, holography, and related topics.

SPIE Optics + Optoelectronics, 15-18 April in Prague, will include the awarding of the 2011 Galileo Galilei Award to Jan Perina (Czech Republic), honorary chairman of SPIE Optics + Optoelectronics since 2007. The exhibition will be 16-17 April at the Clarion Congress Hotel.

SPIE Microtechnologies, 24-26 April in Grenoble, France, will have five conferences on such topics as medical microdevices, nanotechnology, smart sensors, MEMS, integrated photonics, and energy harvesting. Symposium chair is Thomas Becker (Germany).

SPIE Optical Metrology is 13-16 May and will be co-located in Munich with Laser World of Photonics. Conferences and workshops will address the role of optics and lasers in optical sensors and measurement systems, range imaging, videometrics, autonomic navigation, preservation and restoration of art work, and more.

2013 Electronic Imaging

SCIENCE AND TECHNOLOGY

3D imaging and "space dive" earn featured roles

International experts in 3D imaging, digital photography, multimedia processing, mobile displays, computer vision, and related fields will present their latest findings at IS&T/SPIE Electronic Imaging Science and Technology in Burlingame, CA, 3-7 February.

Marking the 25th anniversary of the symposium, the Electronic Imaging program includes approximately 800 presentations in 23 technical conferences on such topics as 3D imaging and metrology; human visualization; perception; color; image processing and capture; computer vision; and designing multimedia on mobile devices.

New program tracks

New this year are two virtual program tracks following 10 keynote talks during the week as well as highlighted talks from the *Journal of Electronic Imaging*. In the latter track, 15 selected authors will present research recently published in the journal.

The keynote track will feature talks on mobile imaging, petapixel photography, the history of the tesseract optical-character-recognition engine, and high-performance visual-data analytics.

Sabine Süsstrunk of École Polytechnique Fédérale de Lausanne (Switzerland), who served as general chair of Electronic Imaging in 2011, will give the first of two plenary talks on the rich "side information" from modern imaging systems that can enable new functionality.

Plenary speaker Steven Seitz, a University of Washington (USA) professor who also directs a computer vision group for Google, will discuss how the world's massive, unorganized photo collection can be transformed into reconstructions and visualizations of sites, cities, and people. His plenary talk will be on Wednesday, 6 February; Süsstrunk will speak 5 February.

Interactive evening events

SPIE and IS&T have planned three evenings of interactive and entertaining events exploring new imaging systems, 3D videos, and the 2012 dive from space by Austrian Felix Baumgartner.

On Monday evening, 4 February, the popular 3D Theatre will screen new, original 3D footage from around the world as part of the Stereoscopic Displays and Applications conference.

The annual demonstration session will be held the evening of Tuesday, 5 February, allowing attendees to see and touch the latest hardware, software, displays, and other products for cutting-edge electronic imaging.

A demonstration and panel discussion on the lessons learned by the video team who recorded the Red Bull Stratos Project "space dive" is planned for Wednesday evening, 6 February. The project enabled Baumgartner to become the first person to break the sound barrier in free fall when he skydived from more than 36 kilometers, or 120,000 feet, in October 2012.

The optical imaging scientists who used 35 cameras to capture Baumgartner's leap will present an inside look at this incredible human achievement.

Other events during the week include a panel discussion moderated by Bernd Girod of Stanford University (USA) on how technology is transforming higher education around the globe and 18 educational courses on digital imaging systems, image processing, analysis, and displays. SPIE member Choon-Woo Kim of Inha University (Republic of Korea) chairs the short course program.

SPIE Fellow Guarav Sharma from University of Rochester (USA) is symposium chair, and SPIE member Sergio Goma, senior director of R&D at Qualcomm (USA), is symposium co-chair.

Conference proceedings papers will be published in the SPIE Digital Library.

More information: spie.org/ei. ■

Courtesy: Red Bull Stratos / Red Bull Content Pool

Cameras are trained on Felix Baumgartner as he prepares to jump out of the space capsule.

About Electronic Imaging

The Electronic Imaging Science and Technology symposium is jointly sponsored by the Society for Imaging Science and Technology (IS&T) and SPIE.

Now in its 25th year, it will be held at the Hyatt Regency San Francisco Airport in Burlingame, CA, 4-7 February.

Program tracks for 23 conferences and 18 educational courses are:

- **3D Imaging, Interaction, and Metrology**
- **Computer Vision**
- **Image Capture**
- **Image Processing**
- **Media Processing and Communication**
- **Mobile Imaging**
- **Visualization, Perception, and Color**

Advertiser Index

SPIE events

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Available on the App Store

ANDROID APP ON Google play

Online

Find all the articles in *SPIE Professional* and more at spie.org/spieprofessional

Photonics West
2 - 7 February
spie.org/pw

Advanced Lithography
24 - 28 February
spie.org/al

SeTBio
Sensing Technologies for Biomaterial, Food, and Agriculture
23 - 26 April
spie.org/setbio

IS&T / SPIE Electronic Imaging
SCIENCE AND TECHNOLOGY
3 - 7 February
spie.org/ei

Smart Structures/NDE
10 - 14 March
spie.org/ss

Microtechnologies
24 - 26 April
spie.org/mt

Medical Imaging
9 - 14 February
spie.org/mi

Optics+ Optoelectronics
15 - 18 April
spie.org/oo

Defense Security+Sensing
29 April - 3 May
spie.org/dss

OTHER IMPORTANT DATES

Check your monthly SPIE Member E-News for Web links to the items below.

- 4 January: Applications due for Arthur Guenther Congressional Fellowship
- 31 January: SPIE Education Outreach grant applications due
- 4-15 February: Winter College on Optics: Trends in Laser Development and Multidisciplinary Applications to Science and Industry
- 6 February: Prism Award winners announced
- 11 February: Abstracts due for SPIE Optics + Photonics
- 15 February: Applications due for SPIE scholarships
- 25 February: Abstracts due for SPIE Photomask Technology
- 12-13 March: Science-Engineering-Technology Congressional Visits Day
- 31 March: Applications due for Michael Kidger Memorial Scholarship in Optical Design
- 1 April: SPIE Alumni Advantage competition ends
- 1 April: Abstracts due for SPIE Remote Sensing and SPIE Security + Defence
- 2 April: Nominations due for SPIE Senior Member

Find detailed information about SPIE conferences at:
www.spie.org/conferences

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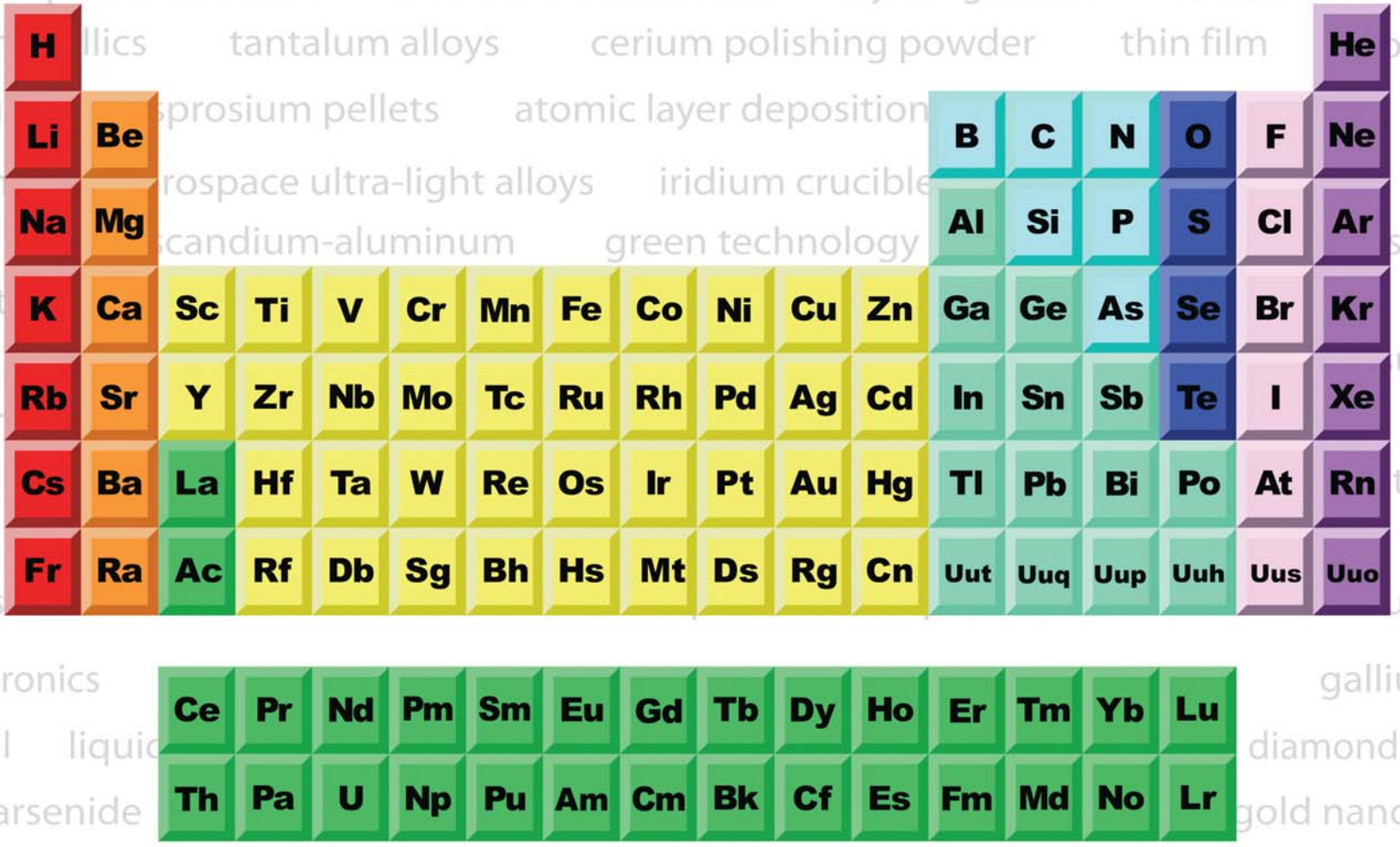

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