GLAD

Laser and Physical Optics Design Software

Full diffraction analysis

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

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

New, Ver. 5.8, 32 & 64 bit

- New resonator examples: bowtie, end pumping thermal distortion, slab configuration
- Complex variables in command language
- Ultra short pulse effects with new coherent gain model

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

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

Three-day Courses:
April 23-25, 2014, Shanghai
Feb. 19-21, 2014, San Diego

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

Applied Optics Research
Tel: 1 360 225 9718, Fax: 1 360 225 0347
E-mail: glad@aor.com, www.aor.com

International Distributors: Leadintex International, Inc., Japan
tel: 81 3 3661 5041, tsutom@leadint.co.jp
Infotek, Shanghai, tel: +86-21-64660708, angie@infotek.com.cn
President’s Letter
SPIE President H. Philip Stahl challenges you to increase your participation in the SPIE family.

Career

6  Career Advice
The 10th annual SPIE Women in Optics planner offers inspiration to science-minded women and girls.

8  Career Myths
See beyond the myths about careers in the optics industry vs. academia.

10 Power via Laser
LaserMotive sees opportunity in fiber-optic cable.

Industry

12 Conflict Minerals
Use of tin, tungsten, tantalum, and gold in opto-electronic products must be disclosed.

13 Finalists for 2014 Prism Awards

15 Photonics in Europe
New research funding under Horizon 2020.

16 OCT Technology
OCT market has plenty of room for growth.

18 Salary Survey

Technology R&D

20 R&D Highlights
Recommendations and highlights from SPIE journals and recent conferences.

Photonics for a Better World

24 Solar Decathlon
SPIE reports on next-generation clean energy solutions.

27 Energy Patents
Growing markets for renewable energy technology.

28 Innovations in Photonics

Membership

30 Destiny in Optics
Meet the 2014 SPIE president.

32 New SPIE Leadership

Education

33 SPIE Student Chapters

34 Dali and Holographic Space
Art and science collaborate for a holographic point of view.

38 New accreditation and new center

Events

39 SPIE Smart Structures/NDE

40 SPIE Photonics West 2014
The biggest conference of the year has an increased focus on photonics commercialization.

44 IS&T/SPIE Electronic Imaging
Experts in electronic imaging move conference to San Francisco.

46 More SPIE Events

48 SPIE Events Around the World
New Books from SPIE

The Wonder of Nanotechnology: Quantum Optoelectronic Devices and Applications
Manijeh Razeghi, Leo Esaki, Klaus von Klitzing (Editors)
When you look closely, Nature is nanotechnology at its finest. From a single cell, a factory all by itself, to complex systems, such as the nervous system or the human eye, each is composed of specialized nanostructures that exist to perform a specific function. This same beauty can be mirrored when we interact with the tiny physical world that is the realm of quantum mechanics.

This book, edited by Manijeh Razeghi and Nobel laureates Leo Esaki and Klaus von Klitzing, focuses on the application of nanotechnology to modern semiconductor optoelectronic devices. Other applications addressed are semiconductor lasers, IR detectors, standoff detection, and energy.

Vol. PM238
SPIE Member $123 / Nonmember $145

Computer-Aided Cancer Detection and Diagnosis: Recent Advances
Jinshan Tang and Sos S. Agaian (Editors)
Accurate imaging of cancerous tissue is a critical step in the fight to lower cancer mortality rates, and computer-aided detection and diagnosis (CAD) technologies play a key role. Over the last three decades, the field of diagnostic cancer imaging has witnessed a remarkable evolution that has affected virtually every aspect of research and clinical management of cancer. This book discusses recent high-quality research in key technologies used in CAD systems; the 11 chapters cover different types of cancers (including skin, breast, prostate, and colon cancer) and different scientific fields (such as biomedicine, imaging, image processing, pattern recognition, and system analysis) to further the major goals of current cancer imaging.

Vol. PM240
SPIE Member $63 / Nonmember $74

Field Guide to Holography
Pierre-Alexandre J. Blanche
Although they are mostly known by the general public for producing beautiful artworks, holograms are used in a variety of technical applications. From nondestructive testing of composite materials to data storage and processing, there are numerous situations where holography is better suited than any other method. This Field Guide presents an overview of the various concepts of holography, including a theoretical foundation and descriptions of the different types of holograms, techniques used to produce them, and the most common recording materials. Written with a large audience in mind—including students, researchers, and engineers—the book provides a broad panorama of the field to help readers understand its concepts and methodology.

Vol. FG31
SPIE Member $36 / Nonmember $42

Optical Satellite Signal Processing 2-VOLUME SET
Shen-En Qian
Vol. PM910
SPIE Member $142 / Nonmember $167

Optical Satellite Data Compression and Implementation
Shen-En Qian
This monograph is your guide to satellite image processing, data compression, and the manipulation and deployment of satellite communications systems. The volume describes a variety of spaceborne optical sensors and their performance measurements. Consisting of 14 chapters, it reviews the relevant theories, algorithms, and system implementations with both postgraduate students and advanced professionals in mind.

Volume 1 of Set: PM230
(SPIE Member $89 / Nonmember $105)

Volume 2 of Set: PM241
(SPIE Member $78 / Nonmember $92)

Field Guide to Displacement Measuring Interferometry
Jonathan D. Ellis
This Field Guide provides a practical treatment of the fundamental theory of displacement measuring interferometry, with examples of interferometry systems and uses. It outlines alignment techniques for optical components, signal processing systems for phase measurements, and laser stabilization for homodyne and heterodyne sources. The concept of displacement measurement uncertainty is discussed with a practical example of calculating uncertainty budgets. For practicing engineers, this Field Guide will serve as a refresher manual for error sources and uncertainty budgets. For researchers, it will bring new insight to the way in which this technology can be useful in their field. For new engineers, researchers, and students, it will also serve as an introduction into basic alignment techniques for breadboard-based optical systems.

Vol. FG30
SPIE Member $36 / Nonmember $42

Read details and sample pages: www.spie.org/books
2014 SPIE Events

**Photonics West** · 1-6 FEBRUARY · San Francisco, CA USA

**SPIE/IS&T Electronic Imaging** · 2-6 FEBRUARY · San Francisco, CA USA

**Medical Imaging** · 15-20 FEBRUARY · San Diego, CA USA

**Advanced Lithography** · 23-27 FEBRUARY · San Jose, CA USA

**Smart Structures/NDE** · 9-13 MARCH · San Diego, CA USA

**Photonics Europe** · 14-17 APRIL · Brussels, Belgium

**SPIE DSS** · 5-9 MAY · Baltimore, MD USA

**Defense + Security; Sensing Technology + Applications**

**Translational Biophotonics** · 19-20 MAY · Houston, TX USA

**Astronomical Telescopes + Instrumentation** · 22-27 JUNE · Montréal, Québec, Canada

**Optics + Photonics** · 17-21 AUGUST · San Diego, CA USA

**Photomask Technology** · 16-18 SEPTEMBER · Monterey, CA USA

**Laser Damage** · 14-17 SEPTEMBER · Boulder, CO USA

**Security + Defence** · 22-25 SEPTEMBER · Amsterdam, Netherlands

**Remote Sensing** · 22-25 SEPTEMBER · Amsterdam, Netherlands

**Asia-Pacific Remote Sensing** · 27-31 OCTOBER · Beijing, China

**SPIE/COS Photonics Asia** · FALL · Beijing, China

White = North America
Gold = Europe
Red = Asia Pacific

www.spie.org/conferences
Do you belong to SPIE?

Do you belong to SPIE? I do not mean, are you just a dues-paying member of SPIE. But are you a member of the SPIE family?

Are you a researcher or educator, an engineer or entrepreneur who is driven by the desire to understand the nature of light and how to use or apply that nature to make the world a better place to live? Do you add to our community’s body of knowledge by contributing to conferences, submitting articles for proceedings or journals, or teaching a course? Do you benefit from participating in our conferences or exhibits or courses?

Do you support our education and outreach programs such as providing student travel grants and scholarships, partially funding the ICTP Winter College on Optics, or advocating for the optics and photonics profession with your elected representatives?

If you answer yes to any of these questions, then you belong to SPIE. You are a member of the family.

And I would like to challenge you to do more, to increase your participation.

Family members volunteer

If you have a favorite conference, then consider volunteering to serve on the organizing committee. Or consider serving on a governance committee. Help increase the knowledge of our community by participating in conferences, submitting your best papers to our journals, or by developing a short course or Field Guide.

Help increase the reach of our educational activities. Judge a local science fair, give a lecture at an SPIE Student Chapter, or visit a middle school and talk about your career. And of course, continue renewing your membership.

I am writing this letter in October 2013 while in Rochester, NY, attending SPIE Optifab. With 166 exhibitors, the organizers proudly declared it as North America’s largest display of optical manufacturing and testing technology and equipment. Three weeks earlier, I was in Dresden attending SPIE Remote Sensing, the largest SPIE meeting dedicated to remote sensing, and the SPIE Security + Defence conference and exhibit. Next, I traveled to Jena and Mainz (Germany) to visit SPIE Corporate Members JENOPTIK, Fraunhofer IOF, Carl Zeiss SMS, and SCHOTT. At Zeiss SMS, we talked about how important the SPIE Photomask conference is to that community.

Connections throughout the world

While SPIE runs a broad range of technical events each year, most of us only attend one – “our” meeting. Just like a large extended family, SPIE has many technical communities. To the photomask community, SPIE Photomask is their most important meeting. To the biophotonics community, SPIE BiOS is most important.

Each SPIE technical community has its own “most important” event: Advanced Lithography; Medical Imaging; Astronomy; Optics + Photonics; and Defense, Security, and Sensing; etc.

In recognition of this fact, we believe that each technical community should have its own journal. For this reason, we have recently announced three new journals covering astronomy, medical imaging, and neurophotonics. (See page 20 for more information.)

From 2005 to 2011, I was privileged to be the SPIE vice president to the International Commission for Optics (ICO). My duties on the ICO Bureau took me around the world. On those travels, I noted that from ancient Greece to medieval Europe, and from Accra, Ghana, to online, all communities share the common need of a central marketplace for goods, services, and information. Just as Rome would not have been the same without its Forum or Prague without its Old Town Square, the optics and photonics community would not be the same without SPIE events, publications, and services.

SPIE is where the global optics community comes to connect, communicate, and conduct commerce in products and ideas. SPIE is the center of our community.

I look forward to seeing many of you at Photonics West – the optics community’s single largest technical conference and exhibit. Much more information about Photonics West can be found inside this issue of SPIE Professional.

Why SPIE?

As SPIE President-Elect, I ran the annual strategic planning in 2013. Central to any strategic plan is defining our ‘core.’ Why does SPIE exist? What motivates our members to dedicate their creative time, talents, and treasure? What would be lost if SPIE ceased to exist?

To me the answers are simple. SPIE is more than a Society, more than staff and buildings in the US and UK. SPIE is a community. SPIE is my family.

I have been thinking about these concepts since before 1990 when I wrote an opinion piece for OE Reports about how SPIE is an international community sharing the common bond of optics and serving the needs of diverse technical communities.

I frequently talk to members who say that of all the professional meetings they go to, the SPIE conference they attend for their “community” is the most important.

And as I travel the world representing SPIE, I am struck by the fundamental need of human communities to have a central gathering place to connect, communicate, and conduct commerce.

SPIE fulfills that need in the optics community.
The optics and photonics professionals featured in the SPIE Women in Optics calendar often say they were inspired by teachers, professors, or parents who encouraged them to continue on a path not generally pursued by women.

The 28 women featured in this year’s calendar share stories of inspiration and discuss the challenges and rewards of their careers and the importance of science, technology, engineering, and mathematics (STEM).

SPIE member Lynore Abbott’s grandmother wasn’t allowed to attend college, because she was, “only a girl.” Her grandmother went on to train as a pilot and later opened a machine shop with Abbott’s grandfather. These experiences, and her grandmother’s love of building things, inspired Abbott to study engineering and eventually create her own company, Logical Marketing, which provides support to photonics and technology companies.

Encouraging the next generation

In the preface of the 10th annual SPIE Women in Optics calendar, SPIE Fellow and member of the SPIE Board of Directors Kathleen Richardson of University of Central Florida (USA) asks women to “consider how you’ve been influenced by someone who took a moment to share a little something with you and how you have ‘paid it forward.’”

Your communication to others, especially those in their early professional stage, can have a lasting impression and impact,” she says. “This is what matters if we are all to continue our movement forward.”

The greatest inspiration for SPIE member Eriko Watanabe of the University of Electro-Communications (Japan) was her mentor and PhD supervisor, SPIE Fellow Kashiko Kodate, of Japan Women’s University.

“My decision to undertake optical research was heavily influenced by her advice and attitude towards work and life,” says Watanabe. “My interactions with female researchers in Japan and abroad have encouraged me to stay active in science and engineering.”

An eye-opening inspiration for Allison Lami Sawyer, CEO and cofounder of Rebellion Photonics (USA) came from her high-school calculus teacher who asked Sawyer if she planned to study engineering at university. When Sawyer answered no, her teacher’s reply was, “Don’t be stupid. You’d be a great engineer.” Sawyer went on to earn a bachelor’s degree in engineering physics as well as two master’s degrees, and her company was named the Wall Street Journal Startup of the Year in November.

Inspiration can also come from outside the classroom, in the form of others who have moved past stereotypes and have succeeded despite obstacles placed in their path.

SPIE Fellow Kyle J. Myers of the US Food and Drug Administration recalls Marcia McBeath, the first female PhD Myers ever met, as her biggest role model. McBeath, a psychologist and author,
DeHarpporte, believes there are “almost endless possibilities” for women who pursue studies in STEM. Through her company, DeHarpporte collaborates with teachers on developing curricula for making science education available to all students.

“Learning about STEM makes the world more interesting and more meaningful, whatever you do,” says DeHarpporte. “STEM is broader and more inclusive than you can imagine, and it will give you the opportunity to put your mark on the world.”

Jana Sanne Huisman, the Photonics21 Young Ambassador of Photonics Education, encourages girls to try a variety of subjects within STEM. Huisman, an SPIE student member at Universität Bonn (Germany), believes that STEM “unlocks new decisions, paths, and alternate worlds – whereby many roads lead to Rome.”

SPIE member Susan Tousi, vice president of engineering at Illumina, describes STEM as, “the most exciting career path imaginable.” She points out that science and engineering are driving the future and that to continue this forward motion, the best and brightest minds will need to be on the job.

“Many of my highest technical contributors have been women,” Tousi says. “We must make use of this rich talent base to make our dreams of the future a reality.”

**Bold and confident women**

Despite advances made by women in science and engineering, obstacles still exist. In such situations, persistence is key.

In male-dominated fields, women are often required to work more than their male colleagues to achieve the same position, says Florenta Costache of Fraunhofer Institute for Photonic Microsystems (Germany). “It is difficult for women, but not impossible, and more and more women find ways to achieve these positions,” she says.

Jennifer Decker, a science and technology department engineer, describes STEM as, “the best and brightest minds will need to be on the job. Out that science and engineering are driving the future and that to continue this forward motion, the best and brightest minds will need to be on the job.”

One of her highest technical contributors has been women,” Tousi says. “We must make use of this rich talent base to make our dreams of the future a reality.”

**The business side of optics**

Business and marketing play important roles in driving the photonics industry and getting new ideas launched.

SPIE member Marisa Edmund, executive vice president of marketing at Edmund Optics (USA), is dedicated to continually learning the science behind optics. “Speaking the language of optics and learning as much as possible about our products is critical to my own development and our marketing efforts,” Edmund says. “I have the unique opportunity to see what’s new in optics and connect with customers on how these products can be utilized.”

SPIE member Amy Eskilson’s career in the business side of science began almost by accident. After studying broadcasting at university, she joined the advertising department of Thorlabs (USA) – a then fledgling photonics catalog company.

Now president and CEO of Inrad Optics (USA), Eskilson has learned over the years not to let preconceived limitations based on gender get in the way. “Assume any barrier you face is addressable with training, education, experience, or grit,” Eskilson says.

**Many roads lead to ... STEM**

STEM education programs seek ways to get students, especially girls, actively engaged in science at an early age. While more women are obtaining degrees in STEM than 30 years ago, there are still fewer girls than boys enrolling in STEM courses and a low ratio of women employed in these fields. Despite the lingering stereotype that girls aren't really interested in science and math, women are making advances in STEM.

The founder of Laser Classroom (USA), Colette DeHarpporte, believes there are “almost endless possibilities” for women who pursue studies in STEM. Through her company, DeHarpporte collaborates with teachers on developing curricula for making science education available to all students.

“Learning about STEM makes the world more interesting and more meaningful, whatever you do,” says DeHarpporte. “STEM is broader and more inclusive than you can imagine, and it will give you the opportunity to put your mark on the world.”

Jana Sanne Huisman, the Photonics21 Young Ambassador of Photonics Education, encourages girls to try a variety of subjects within STEM. Huisman, an SPIE student member at Universität Bonn (Germany), believes that STEM “unlocks new decisions, paths, and alternate worlds – whereby many roads lead to Rome.”

SPIE member Susan Tousi, vice president of engineering at Illumina, describes STEM as, “the most exciting career path imaginable.” She points out that science and engineering are driving the future and that to continue this forward motion, the best and brightest minds will need to be on the job.

“Many of my highest technical contributors have been women,” Tousi says. “We must make use of this rich talent base to make our dreams of the future a reality.”

**Bold and confident women**

Despite advances made by women in science and engineering, obstacles still exist. In such situations, persistence is key.

In male-dominated fields, women are often required to work more than their male colleagues to achieve the same position, says Florenta Costache of Fraunhofer Institute for Photonic Microsystems (Germany). “It is difficult for women, but not impossible, and more and more women find ways to achieve these positions,” she says.

Jennifer Decker, a science and technology adviser at the Canadian Embassy in Germany, adds that women pursuing technical careers should “be bold and confident. “There is power in that – and remember to smile,” Decker says.

SPIE Women in Optics promotes personal and professional growth for women through community-building networking opportunities. The group encourages young women to choose optics as a career.

The SPIE Women in Optics monthly planner showcases the work of women in the field of optics and photonics as inspiration and encouragement to prospective researchers and scientists.

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

– Karen Thomas, SPIE staff
Career myths and realities

Only one big difference between a career in industry and academia

By Nishant Mohan

It is always great to have a choice, and it is always tough to make one. This holds aptly for those with advanced degrees in applied sciences and engineering. During their career journey, they all face the choice of continuing on the road of academic research or turning toward the lanes of the corporate world.

I have had a chance to drive on both these roads and look closely at them. I was most intrigued by the myths that exist regarding the differences between these two avenues. Making a good career choice certainly requires delving deeper than the word on the street and checking out the realities first-hand.

Job in academia or industry?

The biggest myth regarding the difference between academia and industry is that there is a massive abyss between the two. The reality is that academia and industry are getting closer to each other over time, and this is occurring faster than most of us think.

One example of this can be found in the massive government budget cuts around the world, which have led to an increase in academic labs looking for research funding from their industry counterparts. On the other side, there is a growing trend in industry to handle high-risk but scientifically crucial projects in academic settings. In addition, there are now several public funding opportunities that require joint academic and industry proposals.

One such opportunity in the United States is a National Institutes of Health grant for a cancer imaging system that requires the formation of a translational research team that includes both academic and industry scientists. (http://grants.nih.gov/grants/guide/pa-files/PAR-13-169.html)

The growing interaction between industry and academia is inevitably resulting in a merger of cultures as well. I have realized that most stereotypes about academics and industry professionals, from communication skills to lifestyles, turn out to be bogus on closer inspection.

Lab-dwelling scientists are often thought to have mediocre abilities to present and communicate their work. However, the best communicators I have seen over the years were from academia. And I believe it is not that I just happened to be around well-spoken scientists. Rather, it is the result of a growing realization of the importance of good scientific communication in the academic world.

We see the speakers at scientific conferences preparing for days in advance. Only a small set of industry professionals require such preparation on a regular basis.

Other generalizations regarding differences between academia and industry in work-life balance, financial compensation, etc., should not be accepted without looking at the complete picture.

The stereotypes about differences between people working at universities and in industry are nothing but stereotypes. There are all kinds of personalities and positions in both...
academia and industry. You have to look at each particular job description to realize what suits your career and personal goals the best.

Looking at the ‘average’ career in academia or industry is of little use when making a career choice.

Destination is the real difference

So what really is the difference between these two career roads? The answer is their final destination.

The end goal for people in academia is to create knowledge, and the end goal for people in industry is to make products. Academics serve their peer community with impressive research work, while industry professionals serve their customers with useful products and services.

Both these roads will often intersect and even overlap. However, they will always lead to a different destination.

Making a choice between these two paths means choosing a final destination that motivates and brings the best out of you. The roads by themselves will have too many twists and turns to predict in advance.

Also remember one has to make decisions under the constraints of the available options. In case your dream academic or industry positions are unavailable due to prevailing circumstances, don’t give up hope. Dig deeper and you will find that you can create an ideal career path for yourself among the available options.

I highly recommend the career advice book by Reid Hoffman, co-founder of the professional networking website LinkedIn, and Ben Casnocha. It’s titled The Start-up of You and shows how you can adapt to the future, invest in yourself, and transform your career.

Good luck!

–SPIE member Nishant Mohan is director of product management and marketing at Wasatch Photonics, a developer of optical imaging and spectroscopy technologies and optical coherence tomography (OCT) products. Mohan was previously with the R&D division of Bausch + Lomb and a research fellow at Massachusetts General Hospital. He has a PhD from Boston University and an undergraduate degree from Indian Institute of Technology, Guwahati. This article was adapted from an advice column in the SPIE Career Center. (spie.org/ccmohan).

Job fairs in 2014

The SPIE Career Center at spiecareercenter.org has numerous resources for recent graduates and those looking for a better job, including employment ads for engineering, management, and other types of optics and photonics jobs.

In addition, it has scheduled free job fairs at three symposia this year.

• 4-5 February at SPIE Photonics West
• 6-7 May at SPIE DSS
• 19-20 August at SPIE Optics + Photonics

Are we on the same wavelength?

If you are passionate about designing cutting edge optical systems, we certainly are.

From streamlining the design-build process with our industry leading FRED optomechanical design and analysis software to partnering with you as optical engineering consultants, Photon Engineering has the tools and expertise to efficiently turn your concepts into successful products.

Learn more about Photon Engineering’s cost-effective, ground-breaking optomechanical solutions today.

Photon Engineering
Illuminating Ideas

520.733.9557
440 S. Williams Blvd., Suite 106
Tucson, Arizona 85711
www.photonengr.com
Firsts for LaserMotive

LaserMotive, based in Kent, WA (USA), has a number of firsts to its credit.

- 2009: NASA Centennial Challenge win, delivered more than 1000 watts of DC power via laser and transmitted laser power out to a range of 1 kilometer.
- 2010: Longest laser-powered flight on record at 12.5 hours with partner Ascending Technologies. Demonstrated in-flight battery recharging, automatic acquisition of the UAV by the laser-tracking system, all within safe laser exposure limits.

In the 2012 demonstration, the Stalker performed well in the environment and flew both day and night without incident.

“Ultimately, we hope to provide our customers with remarkably long endurance to extend and expand the mission profiles,” said Tom Koonce, Stalker program manager at Lockheed Martin Skunk Works.

Tom Nugent and Jordin Kare have spent almost seven years advancing a technology that uses laser beams for wireless power and propulsion. Starting in 2007, they set out with a hand-picked team to meet the NASA Centennial Challenge in Power Beaming.

The competition centered on a practical demonstration of wireless power transmission, which could have a wide range of applications from lunar rovers and space propulsion systems to the space-elevator concept and airships above the Earth.

LaserMotive, the company they founded in 2007, won the competition in 2009 as the only team that drove laser-powered devices up a cable suspended from a helicopter more than a kilometer high, with power for the cable climber sent by lasers from the ground. The team then set out to apply the free-space laser technology to solve down-to-earth challenges, using NASA prize money of $900,000 to seed the new business.

The entrepreneurs explored the aerospace, defense, and remote-sensing markets that required high powers and wireless technology, with the idea that they could extend into other markets as their capabilities advanced.

“You could use each market as a stepping stone to the next market and keep expanding the performance envelope for solving real-world challenges with the technology,” says Nugent, the company’s president and CEO.

Although the company’s initial focus was on developing a wire-free system to power aerial vehicles, LaserMotive’s first commercial product delivers laser power through fiber-optic cables.

Technology for many markets

The LaserMotive team took that original idea – free-space laser power to keep small, hand-launched aircraft and other unmanned aerial vehicles (UAVs) aloft for days instead of the few hours allowed by limited battery capacity – and validated the technology for additional applications and markets.

First, the team flew a multi-rotor copter for 12.5 hours on a five-minute battery in 2010 by powering and recharging the battery with a laser transmitter.

Then in 2012, in partnership with the Lockheed Martin Skunk Works, the LaserMotive team powered the Stalker UAV for 48 hours continuously by laser beam only in a wind tunnel and then powered it in flight in the desert, at altitudes up to 600 meters. Those flights used LaserMotive’s integrated, lightweight power-distribution system for charging the on-board battery while also powering the motors and controller.

While a NASA-funded project helped LaserMotive explore long-term utility and capability of wireless power transmission, Nugent says the young company also independently created safety features and new functional capabilities that made using lasers safe and reliable in commercial environments.

“When we won the NASA competition,” Nugent says, “we had a specific power and distance performance envelope, having delivered 1 kilowatt of DC output power at half a kilometer of distance...
LaserMotive PoF system safely deliver electric power and research labs all over the world. Could the website, LaserMotive began receiving inquiries from electrical isolation. "People who are very happy to use the fiber-optic cable for unexpected industries approaching us, and people kilometers. "As a few hundred watts over distances as long as 2 efficient to transmit a few watts of power or as much as a PoF unit that demonstrated technology able to efficiently transmit a few watts of power or as much as a few hundred watts over distances as long 2 kilometers. Nugent says LaserMotive had “people in unexpected industries approaching us, and people who are very happy to use the fiber-optic cable for electrical isolation.”

Just days after the product appeared on the website, LaserMotive began receiving inquiries from utility providers, railroads, aerospace companies, and research labs all over the world. Could the LaserMotive PoF system safely deliver electric power to high-voltage sensors and critical equipment in extreme environments? “They had problems with isolating the power systems,” Nugent says, and LaserMotive had a solution. “By delivering the power over fiber, we can opto-isolate their power supply for sensors and other devices that would otherwise get burned out or destroyed in a high-voltage or strong magnetic-field environment.”

Problem meets solution

“Connecting with some of these commercial customers involved some serendipity and shows that the time is right for solving power delivery challenges in key industries,” Nugent says. “Being able to provide unlimited energy without copper electrical wires opens up applications previously impractical or simply impossible.”

While LaserMotive had not anticipated interest from research labs and other market sectors, the team quickly worked to address the needs of these potential customers.

Even though the company tagline says, “Power delivery via laser,” Nugent says LaserMotive is able to deliver “complete end-to-end power solutions and integrate them with customer products.” Voltage regulation, power distribution, battery changing, and, of course, power transmission via laser, are all areas LaserMotive can manage and customize for customers. Nugent says LaserMotive is refining its PoF product line to better meet the demands of customers in those markets who need electrical isolation due to high voltage or sensitivity to RF interference. He can’t yet talk publicly about ongoing projects with global Fortune 500 companies, but he’s excited about the future.

“Long term, there are exciting applications for space propulsion and long-range power delivery to exploration robots on the moon and asteroids,” Nugent says.
For now, Nugent says he and his team are thrilled to be laying down the first, terrestrial “stepping stones” that lead to a bigger future.

Tom Nugent and a demonstrator version of the InvisiTower system.
Conflict Minerals
Use of tin, tungsten, tantalum, and gold must be disclosed.

By Rosemarie Szostak

The conflict minerals — tin, tungsten, tantalum, and gold mined in the Democratic Republic of the Congo (DRC) — are found in an astonishing number of electronics, photonics, and optical devices. These elements are now regulated by the US Securities and Exchange Commission (SEC) under the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act, and publicly traded US companies must be in compliance by May 2014.

The new regulation does not prevent the use of conflict minerals, but does require companies to disclose their use to the SEC. This will require a critical assessment of supply chains to determine if products are conflict-mineral-free. All companies within the supply chain for cell phones, computer chips, light bulbs, and most electronics will have to provide their customers verifiable documentation of their source of these elements from their own suppliers.

According to the US Geological Survey (USGS), the DRC accounts for 4% of tin mined worldwide, 9% of the tantalum, and 1.6% of the gold. Additionally, the DRC produces a 40% share of the world’s cobalt, 31% of the industrial diamond, 6% of gem-quality diamonds, and 2% of copper. These latter minerals are not presently regulated under Dodd-Frank.

Atrocities lead to rule
The DRC is the site of some of the worst humanitarian atrocities in decades, according to a 2010 report from the US Government Accountability Office (GAO). Since 1998, more than five million of its citizens have died in conflicts in the mineral-rich eastern part. Illegal armed groups as well as units of the Congolese military have been involved in half of the mass murders, rapes, and other egregious human rights abuses.

All these groups get their money from

Companies write new policies
Photonics manufacturers are taking steps to ensure compliance with the Dodd-Frank Wall Street Reform and Consumer Protection Act to disclose the use of conflict minerals in their products.

Some, such as IPG Photronics, are going further by creating policies promising that their companies will not knowingly use any metals from sources in or near the Democratic Republic of the Congo.

IPG says it will seek alternative sources of tin, tantalum, tungsten, and gold if suppliers cannot demonstrate “sufficient due diligence documenting that the metals used in the manufacture of our products are conflict free.”

Likewise, Zygo Corp. and its subsidiaries not only will require suppliers to document the countries of origin for the tin, tantalum, tungsten, and gold that it purchases, but all Zygo suppliers must commit to being or becoming “conflict-free.”

Although non-US companies are not directly covered by the rule, many are creating new policies out of a sense of corporate responsibility and/or because they have US customers who will be required to report the conflict minerals used in their products.

Photo U.S. Department of Agriculture, Peggy Greb

Continued on page 14
Photonics companies with new products that solve problems in healthcare, food and drug safety, manufacturing, and other important areas are among finalists for the 2014 Prism Awards for Photonics Innovation. The awards are sponsored by SPIE and Photonics Media.

Winners in each of nine categories will be announced 5 February during SPIE Photonics West in San Francisco.

Entries are judged by an independent panel of optics and photonics experts including photonics industry executives, leading academic researchers, venture capitalists, and past Prism Award winners.

“The broad range of entries reflects the extensive reach and power of photonics in our lives, and is a tribute to the creativity of our extraordinarily entrepreneurial community,” said SPIE Executive Director Eugene Arthurs.

“These new products can improve our ability to diagnose cancer without invading the body, navigate our world with more accurate GPS systems, save money and resources with more efficient solar-energy generation, and advance the manufacturing revolution with the ability to print even micro-sized parts using 3D printers,” he added.

Twelve of the 27 finalists are SPIE corporate members (designated by an asterisk below), and many will be exhibiting at the BiOS Expo (1-2 February) and Photonics West exhibition (4-6 February).

See PrismAwards.org for more information and follow news about the awards on Twitter with #PrismPhotonics.

Finalist companies, in alphabetical order, and their products by category are:

**Advanced Manufacturing**
- Haas Laser Technologies* for Beam Waist Analyzer Monitor
- Innolite for ILENTRIC
- Nanoscribe for Photonic Professional GT

**Defense and Security**
- Hubner for T-COGNITION
- InfraSign for SPoT
- Ocean Optics* for iDRaman mini

**Detectors, Sensing, Imaging, and Cameras**
- BaySpec* for OCI-1000 Handheld Hyperspectral Imager
- Stanford Computer Optics* for XXRapidFrame framing camera
- Tornado Spectral Systems* for OCTANE-860

**Industrial Lasers**
- DILAS Diodenlaser* for Fiber-Coupled, Multi-Single Emitter Module
- PolarOnyx Laser* for Uranus mJ
- V-Gen for VPFL-ISP-1-40-HE-50000

**Life Science and Biophotonics**
- AccuVein for AV400 Vein Viewing System
- Holomic for Rapid Diagnostic Reader (HRDR-200)
- Optofluidics* for Nano Tweezer

**Optics and Optical Components**
- Arrayed Fiberoptics for Non-contact optical fiber connector
- Compass Electro-Optical Systems for r10004 Router
- Si-Ware Systems for MEMS FT-IR Spectrometer

**Other Light Sources**
- CoolLED Ltd. for pE-4000
- Necsel for Frequency Converted Green Laser Array
- QD Laser* for Compact 561nm laser module

**Scientific Lasers**
- Amplitude Technologies* for PULSAR PW
- Hübner for C-WAVE
- Lockheed Martin* for Argos Orange

**Test, Measurement, Metrology**
- Pie Photonics Ltd. for PieX™
- Si-Ware Systems for MEMS FT-IR Spectrometer
- Zygo* for Nexview™ Optical Surface Profiler
Special concerns for defense industry

The new US rule on reporting of conflict minerals is putting suppliers in the defense industry “between a rock and a hard place.”

The disclosure requirement applies only to publicly traded US companies, but a recent Defense News article notes that many companies in the defense sector are private for security reasons.

“That creates something of a problem for prime contractors in particular,” the newspaper reports, “because they must get information from privately held subcontractors in order to verify the origin of all the minerals in the systems they acquire.”

Adds Micah Edmond of the Aerospace Industry Association, “How do you compel those individuals to supply that information when they’re not required to?”

Conflict Minerals

Continued from page 12

economic activities in the area, including mining. This is accomplished by levying illicit taxes on the minerals extracted at the mine site, illegal tolls levied on transportation routes, and by circumventing legal, taxed, trading activities.

It is estimated that 20 to 40% of the financing of these armed groups comes from illegal taxes on mining.

Complex supply chain

In the DRC, tantalum, tin, and tungsten are mined as the ores columbite-tantalite, or coltan, (tantalum), cassiterite (tin), and wolframite (tungsten). In many mines, these ores are collocated and are mined by individuals with rudimentary picks and shovels.

Once extracted, these minerals are then sold to small-scale traders at the mine sites. The traders hire porters to carry 100-pound sacks of the minerals out of the area by foot to consolidation points. It is here they are mixed with loads from other mines and transported by truck or airplane to the border.

At the border, the loads are sold to trading houses which pack them in lots of 25 tons. From these border points, the trading houses export the minerals both legally (declared to the DRC authorities) and illegally (not declared) to mineral trading houses in neighboring countries.

The DRC-origin minerals are mixed with those received from other mines in the region before they finally leave the African continent for the smelters (mostly in Asia). The smelters receive the shipments and mix them with mineral stock from other countries.

Supply chain transparency

Many large companies, active in the area of corporate responsibility, publish supplier codes of conduct which now include sections on procurement of products containing conflict minerals. They acknowledge that the supply-chain network is complex and fluid.

Intel and HP are proactive leaders. Apple, another leader in supply-chain transparency, identified 287 of their suppliers that use one of the conflict minerals in their products in 2011. This number jumped to 662 in 2012 as Apple continues to press its suppliers for information. (Note that the number of unique suppliers is roughly half these values since many components use more than one of the conflict minerals but each element must be traced back to its source.)

Unintended consequences

Many groups are concerned about unintended consequences of the ruling. An embargo of these minerals suspected to originate from the DRC, whether from illegal activities or not, may not change the violence or human-rights violations in the area.

Even the GAO has noted that even though reducing the illicit incomes of armed groups and some Congolese military units might diminish the incentive for their members to remain in the area, “it is difficult to determine the extent to which their numbers or involvement in human-rights violations would be reduced.”

From a humanitarian perspective, it may ultimately hurt the artisanal miners and their families by taking away their sole source of income.

Major technology advances in optics and photonics may be hindered, delayed, or abandoned as researchers might be pressured not to explore the use of tin, tungsten, tantalum, or gold in innovative new components or products if it might trigger future cost of compliance with the conflict-minerals rule.

The costs associated with complying with Dodd-Frank could prove to be excessive for companies both large and small and potentially devastate small manufacturers in the supply chain or those who want to enter a supply chain. Suppliers who are considered low risk may be awarded the contract over suppliers who are labeled high risk.

Developing tools for compliance

Although IPG Photonics, Zygo, Hamamatsu, and other photonics manufacturers are taking steps to ensure compliance with Dodd-Frank, a surprising number of major optics companies have not yet begun to develop compliance tools. Others are in the beginning stages. Some hope that the courts will strike down the law.

Thus it is not surprising that many supply-chain vendors are not sure what will be expected of them. At present, there is no ‘best place’ to go to seek information or assistance. However there are a myriad of organizations offering to help, ranging from law firms to corporate social responsibility associations to consulting firms and software/dashboard developers.

If your gadget contains tungsten, tin, tantalum, or gold – even as small as a nanodot – it must comply with Dodd-Frank.

–Rosemarie Szostak is a frequent contributor to SPIE Professional. She is a senior analyst with Nerac Inc. where she advises clients in the areas of innovation, materials, specialty chemicals, renewable energy, sustainability, and intellectual property matters. She has a PhD in chemistry from University of California, Los Angeles.
Photonics opportunities in Europe’s Horizon 2020

Photonics21 and the Photonics Unit of the European Commission will hold an information and networking day in Brussels 16 January on photonics-related funding under the European research and innovation program, Horizon 2020.

The European Parliament approved a budget of nearly €80 billion for Horizon 2020, including some €17 billion for the “Leadership in Enabling Industrial Technologies” (LEIT) area where applied photonics project funding will be largely represented.

Representatives from Photonics 21 and the EC will provide information on the calls published in December that list funding opportunities for biophotonics research; development of novel materials and systems for organic LED lighting; laser-based manufacturing; thin, organic and large-area electronics (TOLAE); and a host of other photonics topics.

A variety of information and communication technologies (ICT), such as sensing for safety and civil security and photonic integrated circuits (PICs), are also included in the research program that begins this year and runs through 2020.

Horizon 2020 replaces the Seventh Framework Programme for Research (FP7), which ran from 2007 to 2013 with a budget of around €55 billion. The new program is designed to deliver results that make a difference in people’s lives.

Built on three pillars, industrial leadership, excellent science, and societal challenges, Horizon 2020 brings all EU-level funding for research and innovation under one roof, provides a single set of rules, and will radically slash red tape. The overarching goal is a more coherent, simpler program that will make it easier for smaller research organizations and small businesses to participate.

Photonics21 will play a major role in Horizon 2020. The European photonics technology platform has officially established a Photonics Public-Private Partnership (PPP) Association as the first step in a €7 billion joint program with the EC under Horizon 2020.

The Photonics PPP will be officially launched at the Photonics 21 annual meeting 27-28 March in Brussels.

Find more information about the information day and funding calls in the online version of this article at spie.org/spieproJan14.
The first commercial optical coherence tomography (OCT) imagers were introduced to ophthalmology by Advanced Ophthalmic Devices (now owned by Zeiss Meditec) in 1992. Since then, the market for OCT systems has grown at an impressive compounded annual rate of about 45%.

This segment of the biophotonics marketplace has flourished because OCT enables sub-surface imaging of translucent or opaque materials, such as human tissue, in real time at micron resolution and without the use of ionizing radiation. As a result, last year’s global sales of all OCT systems exceeded $400 million and the market now supports more than 36 OCT systems companies, according to OCT News (octnews.org).

Rapid market growth will likely continue as clinical acceptance of OCT for biomedical imaging becomes more widespread and non-medical OCT applications emerge in areas like non-destructive evaluation and security. In fact OCT has so far been successfully commercialized for only two medical specialties — ophthalmology and cardiology — so it has plenty of room to grow!

At the same time, extensive development activity is leading to technical advances that are increasing OCT’s utility and will fuel market growth. Recent OCT developments are wide-ranging and include novel light sources that can extend the imaging range, innovative probe-delivery methods, and the combination of OCT with other imaging techniques. Even the futuristic Google Glass has emerged as a potential component of an OCT system.

OCT technology basics

Optical coherence tomography is a non-invasive imaging technique that is analogous to ultrasound. However, instead of using reflected sound to create an image, OCT uses reflected infrared (~800-1310 nm) light.

The output image is constructed by measuring with low-coherence interferometry the echo time delay and wavelength of light that is backscattered or back-reflected from the microstructural features within the material being probed. Imaging can be performed in real time and in situ with resolution that ranges from 1 to 15 microns, orders of magnitude finer resolution than that of current clinical ultrasound systems.

Early OCT systems were based on time-domain (TD) optical technology. They used a mobile reference-arm mirror to sequentially measure the light echo time delay with acquisition speeds of 400 axial scans (A-scans) per second and axial resolution of 8-10 µm. Inherently long acquisition times were due to the moving reference mirror and limited the utility of the technique, especially in ophthalmology where eye movement such as blinking prevented precise mapping of retinal tissue.

Spectral domain OCT (SD-OCT) succeeded TD-OCT and addressed some of its limitations. Use of a broadband source centered at ~800-850 nm combined with a stationary reference arm and a high-speed camera spectrometer enabled the entire signal at all wavelengths to be acquired in parallel. Fourier transformation (FT) of the signal provided the spatial information. With no moving parts and high-speed processing the scan speed of SD-OCT was 50-1000 times faster than the TD technique.

OCT system for cardiology

US-based healthcare manufacturer St. Jude Medical launched its optical coherence tomography (OCT)-assisted system for imaging coronary arteries in the Japanese and US markets in 2013.

The “ILUMIEN OPTIS PCI Optimization” system is a physician’s tool for assessing patients with coronary artery disease.

The new platform combines fractional flow reserve (FFR) technology, used to measure blood-flow blockage inside coronary arteries, with intravascular OCT imaging.

The OCT imaging part, based on technology originally developed by James Fujimoto and colleagues at MIT, generates a 3D reconstruction of a patient’s blood vessel in real time. Fujimoto is a co-founder of LightLab Imaging, a company acquired by St. Jude Medical in 2010.
The improved acquisition speed of SD-OCT reduced motion artifacts, but other SD benefits included an increased area of retinal coverage, the ability to produce three-dimensional data sets to create topographic maps with precise registration, and better resolution. Today’s current generation of spectral/Fourier OCT systems can achieve 100,000 A-scans per second with axial resolution of 3-5 µm and up to 250,000 A-scans/second at 5-10 µm resolution.

More recently, another form of FT-OCT emerged. Instead of a broadband superluminescent diode laser, swept-source OCT (SS-OCT) uses a narrowband light source typically centered at ~1050 nm that can emit at multiple wavelengths and is scanned sequentially through individual wavelengths to build up the interferogram. Since the axial resolution in OCT is related to the bandwidth of the source, a wider span of wavelengths in the light improves the axial resolution.

Also, the increased operating wavelength compared to SD-OCT means the light penetrates tissue better and with less scatter, allowing imaging of deeper structures. Typically SS-OCT also provides still faster scan speeds, achieving >200,000 A-scans/second with ~5-7 µm axial resolution.

In addition to ophthalmology and cardiology, OCT is being evaluated for many other clinical applications and there are uses for OCT that span medical specialties. These include, for instance, optical biopsy as an alternative to traditional excisional biopsy and real-time guidance of surgical procedures.

OCT-guided procedures are “just starting to happen,” according to Eric Swanson, editor of OCT News and co-inventor of OCT technology. “It’s exciting to watch the market start to transition from purely diagnostics to include therapeutic opportunities as well,” he said.

Clinical options for OCT

A recently introduced swept-source OCT system (from Thorlabs) uses a MEMS-based tunable vertical cavity surface emitting laser (VCSEL) optimized for OCT. Swept OCT sources generally use a relatively long external laser cavity — sometimes up to a few meters — with an intracavity filter or wavelength-selective mirror for tuning, but the output is multimode. The MEMS VCSEL is based on a Fabry-Perot cavity that’s only a few microns long. The device has a free spectral range (FSR) of more than 100 nm, enabling mode-hop-free single-mode tuning over the entire FSR.

The result is that the VCSEL has a coherence length much longer than other OCT swept sources and delivers an OCT imaging range five times that of other SS systems, according to the manufacturer. (See http://dx.doi.org/10.1117/12.911098 for a description of this light source.)

The long-range imaging capability has particular benefits in ophthalmology where it now makes possible simultaneous imaging of the anterior eye and measurement of the full length of the eye from the cornea to the retina in a single OCT acquisition. At the same time, long-range imaging offers benefits in non-medical applications because it allows non-destructive evaluation of 3D structures using rapid, high-resolution volumetric imaging that could be a major boon in manufacturing quality assurance.

The application of OCT for endomicroscopic imaging of the gastrointestinal (GI) tract is relatively early in the process of gaining clinical acceptance and regulatory approval. Among the techniques being explored is a novel method of delivering the imager that is based on a small tethered capsule instead of the more traditional endoscope.

Researchers at the Wellman Center for Photomedicine at Massachusetts General Hospital (USA) have developed the capsule, which is about the size of a large pill and contains the optics required to transmit and collect light. The tether contains a driveshaft and an optical fiber.

Once the capsule is swallowed, it provides 3D images as it is moved up and down the digestive tract by means of the tether. Besides being less invasive than standard endoscopy, use of the capsule does not require that the patient be sedated. Furthermore, the device is reusable and relatively inexpensive; making tethered capsule OCT imaging a potentially very attractive clinical option. The new technique will be the subject of several presentations at BiOS, part of SPIE Photonics West in February. (For more on tethered capsule endomicroscopy, see ow.ly/rdoL0.)

Continued on page 19
Which disciplines have workers who are happiest? Hardest working? Highest paid?

These answers are extracted from the SPIE Global Salary Survey, the largest survey of its kind in the optics and photonics community. Over 6,500 people from 103 countries participated in the 2013 survey, sponsored by the SPIE Career Center.

### Happiest

<table>
<thead>
<tr>
<th>Discipline</th>
<th>% who say “I enjoy my work.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy/Astrophysics</td>
<td>89%</td>
</tr>
<tr>
<td>Civil/Environmental</td>
<td>89%</td>
</tr>
<tr>
<td>Physics</td>
<td>89%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>88%</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>88%</td>
</tr>
</tbody>
</table>

### Hardest Working

<table>
<thead>
<tr>
<th>Discipline</th>
<th>% working over 50 hours per week.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>35%</td>
</tr>
<tr>
<td>Semiconductor</td>
<td>33%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>32%</td>
</tr>
<tr>
<td>Chemical</td>
<td>32%</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>32%</td>
</tr>
</tbody>
</table>

### Highest Paid

<table>
<thead>
<tr>
<th>Industry</th>
<th>Average Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>$113,500</td>
</tr>
<tr>
<td>Semiconductor</td>
<td>$104,018</td>
</tr>
<tr>
<td>Illumination</td>
<td>$96,795</td>
</tr>
<tr>
<td>Systems engineering or research</td>
<td>$96,313</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$85,011</td>
</tr>
</tbody>
</table>

Interested in more data on salaries, workload, satisfaction, and related topics? Download the SPIE 2013 Optics and Photonics Global Salary Report at [SPIECareerCenter.org](http://SPIECareerCenter.org).

Would you like to suggest a salary-related question for future publication in *SPIE Professional*? Submit your question to salarysurvey@spie.org. Questions with broad relevance are most likely to be accepted.
Dual modality imaging

Increasing the clinical utility of imaging techniques is generally a function of the physical apparatus used to create the images, but it is also dependent upon making the results (images) as unambiguous as possible. The combination of OCT and other imaging modalities can reduce ambiguity.

In one example of dual-modality imaging, researchers at the University of Western Australia recently reported demonstration of a needle probe that combined OCT and fluorescence imaging. The probe uses double-clad fiber that guides the OCT signal and fluorescence excitation light in its core and collects and guides the returning fluorescence in the inner cladding. The fiber is interfaced to a modified swept-source OCT system.

The researchers were able to show that the combined technique provided improved tissue differentiation compared to OCT alone.

OCT and Google Glass

Several emerging OCT technologies are poised to further expand the scope of OCT imaging. Micro-OCT, for instance, is currently the highest-resolution OCT available. It provides one-micron resolution in all directions and is capable of cellular-level imaging that enables researchers to see interactions between individual cells.

“The ability to focus down to one or two microns over a large depth provides remarkable images,” says Guillermo Tearney, associate director of the Wellman Center. “Cellular level resolution will allow better cancer diagnosis than does conventional OCT, as well as the ability to diagnose a wider range of diseases,” he says.

Such advances will enhance significantly our understanding and management of disease as well as ensuring that sales of OCT systems continue to grow at a healthy rate.

As for Google Glass, researchers working in SPIE Fellow Stephen Boppart's group at the University of Illinois at Urbana-Champaign (USA) are exploring the potential of pairing Glass with an OCT system to improve patient care.

Developments in light sources, delivery, and detection have all served to advance OCT, but the output images still have to be displayed on a monitor. Graduate student Guillermo Monroy, an SPIE student member, notes that the integration of a head-up display, like Glass, allows real-time display and analysis of image and patient data while enabling the physician to stay focused on the patient.

Such technologies can help the physician efficiently and accurately assess the patient's condition and ultimately benefit the overall quality of care.

Monroy will provide an update of this work 3 February at a BiOS conference on diagnostic and surgical guidance systems (Paper 8935-39).

–Stephen G. Anderson is industry and market strategist for SPIE.
R&D Highlights

Neurophotonics

Newest SPIE journal to launch in mid-2014.

The newest SPIE journal, Neurophotonics, will focus on novel optical technologies for imaging and manipulation of brain structure and function.

Research in this area is driving profound advances in understanding brain phenomena such as electrical excitability, neuroglial physiology, neurovascular signaling, metabolic activity, and hemodynamics in health and disease.

And it comes at a time when agencies in the US, Europe, and other areas prepare to invest significant sums into researching and understanding the human brain.

In the US, the National Institutes of Health (NIH) Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative aims to map the activity of every neuron in the human brain, while the European Commission’s “human brain initiative” has been selected as a flagship research theme for the next decade.

“As advanced optical methods are driving a revolution in the neurosciences that will persist for decades to come, I am delighted that SPIE is starting Neurophotonics,” said editor-in-chief David Boas of Massachusetts General Hospital, Harvard Medical School. “The journal will provide a highly visible focal point to facilitate and accelerate the rapidly expanding impact of this discipline.”

Boas, an SPIE member who will discuss functional brain imaging in February at the BiOS Hot Topics event, part of SPIE Photonics West, said a key goal of Neurophotonics will be to foster greater awareness and interaction among the photonics, neuroscience, and clinical communities.

Neurophotonics will be published quarterly both in print and online in the SPIE Digital Library, with each article published online immediately on completion. Articles will be freely available through 2015.

“Photonics is having an incredibly important impact in medicine and health care,” said William Arnold, the 2013 SPIE President. “SPIE is pleased to focus even more attention on this exciting field with new conference programs on neurophotonics and optogenetics and now a dedicated neurophotonics journal.”

“The journal will provide a highly visible focal point to facilitate and accelerate the rapidly expanding impact of this discipline.”

—David Boas, Editor-in-Chief

Interdisciplinary platform

The SPIE Journal of Biomedical Optics has included papers covering neurophotonics since 1996. Its editor-in-chief, SPIE Fellow Lihong Wang of Washington University in St. Louis, said that the rapid growth and interest in this field has created a distinct need for a spin-off journal focused solely on the application of photonics technology and techniques in brain research.

“I view Neurophotonics as a companion journal and applaud SPIE’s commitment to the biomedical community,” Wang said. “I also expect this new journal to serve as an interdisciplinary platform for both optical engineers and neuroscientists.”

Neurophotonics is one of three new journals SPIE is launching in 2014. The others are the Journal of Medical Imaging (JMI), edited by SPIE member Maryellen Giger of the University of Chicago (USA), and the Journal of Astronomical Telescopes, Instruments, and Systems (JATIS), edited by SPIE member Mark Clampin of the NASA Goddard Space Flight Center.

JATIS responds to the need expressed by the astronomical instrumentation community for a high-quality, peer-reviewed journal focusing on the technologies and techniques covered in the astronomy programs at SPIE Astronomical Telescopes and Instrumentation and SPIE Optics + Photonics, said Clampin.

JMI and JATIS will be published quarterly in print as well as online in the SPIE Digital Library. Individual papers will be published online as soon as each is ready. The online versions will be freely available through the end of 2015.

For more information on the three new journals:

• spie.org/neurophotonics
• spie.org/JATIS
• spie.org/JMI
Photomask challenge for 14 nm node

SPIE Fellow John Sturtevant of Mentor Graphics discusses the challenges of the 14 nanometer (N14) technology mode for wafer modeling and photomask suppliers in a presentation at 2013 SPIE Photomask Technology and in a technical article in the SPIE Newsroom.

Sturtevant says that optical proximity correction (OPC) models must be improved before the semiconductor lithography industry can efficiently move to N14.

In the SPIE Newsroom article, he makes three recommendations for wafer OPC modeling teams, mask suppliers, and the International Technology Roadmap for Semiconductor lithography committee.

Sturtevant, director of RET product development in the Design-to-Silicon Division at Mentor Graphics, says wafer OPC modeling teams should first trace the origin of all mask-related inputs into a model calibration engine and establish the uncertainty associated with these inputs.

“They should ensure that the mask corner rounding is properly represented, use a 3D mask model, and account for mask critical dimension (CD) target deviations,” he says.

“Second, mask suppliers should confirm XZ topography, especially sidewall angle, and any dependence on feature type, proximity, or local pattern density. They should also confirm XY corner rounding and pattern dependency, and they should address post-processing thickness, real and imaginary refractive indices, and associated uncertainties.

“Mask suppliers can also calibrate mask proximity models for systematic CD errors to remove such errors at mask write and improve the wafer OPC model.”

Sturtevant also cautions that mask suppliers need to understand the impact of transient effects beyond anchor CD. “It would also be helpful if the International Technology Roadmap for Semiconductor lithography committee tightens the specifications for CD, phase, and transmission errors for N14 technology,” he says.

Sturtevant also cautions that mask suppliers need to understand the impact of transient effects beyond anchor CD. “It would also be helpful if the International Technology Roadmap for Semiconductor lithography committee tightens the specifications for CD, phase, and transmission errors for N14 technology,” he says.

Sturtevant was co-author of two papers at Photomask 2013. He was also co-author on a paper presented at SPIE Advanced Lithography 2013 on the impact of N14 photomask uncertainties on computational lithography solutions. He describes those challenges in an SPIE Newsroom video at spie.org/videoN14.

Read his full article in the SPIE Newsroom: spie.org/newsN14.

Ocean Sensing

A new SPIE tutorial text authored by SPIE member Weilin Hou, an oceanographer at the US Naval Research Lab, provides background, basic principles, and recent developments in the field of ocean sensing and monitoring.

The book, Ocean Sensing and Monitoring: Optics and Other Methods, is available in print or as an eBook at SPIE.org.

It contains overviews of physical, chemical, biological, and geological oceanography and other remote-sensing technologies needed by those who assess reef changes, fisheries, off-shore oilfields, seismic activity, and other ocean properties and conditions.

Illustrations add to the reader’s understanding of underwater and remote-sensing topics such as diver visibility, lidar techniques, and active underwater imaging and its comparison to sonar.
The angular momentum possessed by a beam of light is a quantity of scientific and technological interest. Scientifically, the nature of light’s angular momentum in matter seems somewhat enigmatic; two rival formulations are available for the calculation of light’s angular momentum, named after their original proponents, Max Abraham and Hermann Minkowski.

Technologically, the prospect of harnessing the torque that angular-momentum-carrying light can exert on tiny objects is appealing for optical applications in micromanipulation, communications, and information encoding. Further technological avenues are opened up if the light in question happens to be a surface-plasmon-polariton (SPP) wave.

These are surface waves which are bound to the interface of a metal and a dielectric material. The tight confinement of these SPP waves to the metal/dielectric interface has enabled them to be successfully exploited in highly sensitive chemical and biochemical sensors, including single-molecule detectors, as well as in nanoantennas and integrated circuitry.

The angular momentum of SPP waves provides the setting for a theoretical study recently published in the Journal of Nanophotonics. The authors, Xuerong Xiao, SPIE member Muhammad Faryad, and SPIE Fellow Akhlesh Lakhtakia from Pennsylvania State University (USA), take the novel step of considering a nanostructured thin film as the dielectric material to partner a metal to support the propagation of SPP waves.

Specifically, the nanostructured thin film they consider is a sculptured nematic thin film, which is periodically nonhomogeneous in the direction normal to the interface. This periodic nonhomogeneity is a key characteristic: an isotropic dielectric material partnered with a metal supports only a single SPP wave whereas a periodically-nonhomogeneous dielectric material partnered with a metal can support a multitude of SPP waves, each with their own phase speed, attenuation rate, and spatial field profile.

Building on previous research

In fact, the Penn State group was first to report this multiplicity of SPP waves — both theoretically and experimentally — in a series of papers published earlier in the Journal of Nanophotonics.

Multiple SPP waves offer greater opportunities for optical sensing, in terms of multi-analyte detection and improved error reduction, as well as multi-channel optical communication.

In the present study, “Multiple trains of same-color surface-plasmon-polaritons guided by the planar interface of a metal and a sculptured nematic thin film. Part VI: Spin and orbital angular momentums,” the authors calculated both the orbital and spin contributions to the SPP's angular momentum, using both the Abraham and Minkowski formulations.

They demonstrated that the periodic nonhomogeneity of the sculptured nematic thin film affords a variety of directions for the orbital and spin contributions to the SPP angular momentum and can also significantly enhance the magnitudes of these momentum contributions.

Furthermore, as the optical properties of the sculptured nematic thin film can be tailored at the fabrication stage, the magnitudes and directions of the orbital and spin contributions to the angular momentum for a multiplicity of SPP waves can be engineered.

Source: http://dx.doi.org/10.1117/1.JNP.7.073081.

—SPIE Fellow Tom Mackay of University of Edinburgh (UK) is co-chair of the Nanostructured Thin Films conference at SPIE Optics + Photonics and a member of the Journal of Nanophotonics editorial board.

The book collects research breakthroughs in quantum engineering that have created light detectors and emitters over a spectral range of 0.2 to 300 µm, including LEDs in the deep-ultraviolet to visible wavelengths and quantum cascade lasers and focal-plane arrays in the infrared based on quantum dots.

“Advances in material science at the nanometer scale are opening new doors in the area of optics and electronics,” according to SPIE Fellow Nibir Dhar, program manager with the US Defense Advanced Research Project Agency (DARPA).

“The ability to manipulate atoms and photons and fabricate new material structures offers opportunities to realize new emitters, detectors, optics, ever-shrinking electronics, and integration of optics and electronics,” Dhar writes in an essay in the book. “Imaging technology has the opportunity to leverage these developments to produce new products for military, industrial, medical, security, and other consumer applications.”

In addition to editing the 32 chapters in the book, each of the three editors has contributed introductory comments.

Klitzing, director of the Max Planck Institute for Solid State Research in Germany and recipient of the 1985 Nobel Prize in Physics for his discovery of the integer quantum Hall effect, pays homage to nature as the ultimate nanotechnology in the book's preface.

“The wings of a butterfly, the feather of a peacock, the sheen of a pearl — all of these are examples of nature's photonic crystals,” von Klitzing says. “As our tools to manipulate matter reach ever smaller length scales, we, too, are able to join in the game of discovery in the nanoworld — a game that nature has long since mastered.”

Razeghi, director of the Center for Quantum Devices at Northwestern University (USA) and a pioneer in quantum materials, also writes about connections to nature in an introduction.

Esaki, who shared the 1973 Nobel Prize in Physics for his discovery of the phenomenon of electron tunneling, is president of the Yokohama College of Pharmacy and best known for his invention of the Esaki diode.

More information: spie.org/wonderTech.

---

Photonics in Taiwan

The SPIE Student Chapter at National Taiwan University (NTU) was the first of two Taiwanese audiences to hear talks in early December by SPIE Executive Director Eugene Arthurs on the state of the photonics.

The NTU visit was hosted by SPIE Board Member Din Ping Tsai, head of the university's Photonics, Nano-Science and Technology Lab at and director of the new Research Center for Applied Science of the Academia Sinica.

Arthurs was also among plenary speakers at Optics & Photonics Taiwan, the International Conference (OPTIC) 2013, chaired by SPIE Fellow Cheng-Chung Lee of National Central University (NCU).

SPIE Past President James Wyant of University of Arizona (USA), along with SPIE President-Elect Toyohiko Yatagai of Tsunomiy University (Japan) and SPIE Fellows H. Angus Macleod of the Thin Film Center (USA) and Xiang Zhang of University of California, Berkeley (USA), also gave plenary talks.

OPTIC 2013 was the site of the Taiwan Photonics Society (TPS) annual meeting where it was announced that Tsai was elected TPS president.

The TPS also awarded its Photonics Engineering and Active Learning in Optics Research and Active Learning in Optics programs.

More information: ow.ly/prtzR.

---

Winter College on Optics 2014

The 2014 Winter College on Optics will focus on theory, devices, applications, and other fundamentals of photonics 10-21 February at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

SPIE Fellow Maria Calvo, SPIE member Lorenzo Pavesi, along with Pavel Cheben and Luis V. Ponce, will be co-directors.

SPIE is a co-sponsor of the Winter College and will once again provide poster prizes and complimentary access to the SPIE Digital Library for participants.

Throughout the year, SPIE collaborates with the ICTP by providing support for the ICTP-INFN-SPIE Quantum Cascade Laser Lab, the Trieste System Optical Sciences and Applications (TSOSA) Committee, Electronic Journal Delivery Service (e-JDS), and the Anchor Optics Research and Active Learning in Optics and Photonics (ALOP) programs.

More information: ow.ly/prtzR.
A lone coyote patrolled a scrub-filled field next to one of the abandoned runways of the former Marine Air Station El Toro in Irvine, CA. But not far away, 19 homes equipped with the latest innovations in solar design and engineering teemed with visitors. More than 60,000 people came to the site at Orange County Great Park over two long weekends in October for the Solar Decathlon.

It was the sixth time the Department of Energy (DOE) sponsored the event in the United States but the first time outside of Washington, DC. Besides the obvious benefits of exposure to a new audience, the contest made the best of the more dependable California sunshine, although there was some rain one day, and the first weekend was a challenge with hot temperatures and 50-mph Santa Ana winds.

The Solar Decathlon is a showcase for optics and photonics technologies and innovative energy-efficient design that prepares the next generation of innovators and entrepreneurs in clean-energy technology.

Competing university teams designed and built houses of under 1000 square feet over a two-year period. The structures were then shipped to California and reassembled. For eight days in October, thousands of visitors toured the solar-powered, energy-independent homes at the former military air base.

The decathlon consists of judging in 10 categories ranging from energy efficiency in doing a load of laundry to more subjective areas like hosting and preparing a dinner for fellow competitors in their houses.

Every team wins

Team Austria, the first-place winner overall, was made up of students from the Vienna University of Technology. The second-place finisher was Team Las Vegas (University of Nevada Las Vegas). Team Czech Republic, from the Czech Technical University, finished third.

But bragging rights for the best solar home are not limited to those three entries. The University of Southern California
earned the most points in the Appliances contest, outperforming the rest in running its refrigerator, freezer, washer, dryer, and dishwasher, to mimic the appliance use of an average US house. And it wasn’t just a cliché, but “everyone was a winner” in the Energy Balance contest. All teams earned the full 100 points for producing at least as much energy as their homes needed during the contest week.

At the end of the competition, fewer than seven points out of a possible 1000 separated the top three finishers. The People’s Choice Award for the visitors’ favorite house in the competition went to the University of North Carolina at Charlotte.

The Austrian team finished third in the Engineering contest to clinch the win. The Engineering winner was Team Ontario (Queen’s University, Carleton University, and Algonquin College), and the Czech Republic team was second.

Ontario’s house, named ECHO, featured a 7.8-kW photovoltaic array of 30 panels, as well as four solar thermal panels to meet its energy requirements. A predictive shading system used an algorithm to calculate optimal shading on the south-facing glazing every hour, based on real-time weather data. Part of Ontario’s innovation was a super-insulated building envelope made from vacuum insulation panels (VIP), which are used in refrigerators and microwaves by Panasonic.

“We built a test study at Carleton University and exposed it to winter conditions in Ottawa,” said Matthew Shiedel, systems manager for Team Ontario. The effective R-value, or rating for insulation efficiency, of the Ontario VIP system was R-53, better than twice that of a typical Ontario home, he said. This drastically reduced the overall heating and cooling loads in the Ontario climate, and “gave us the opportunity to create an optimal, energy-efficient mechanical system.” A solar-assisted heat pump regulated space heat, space cooling, and domestic hot-water requirements.

Solar designs scale up

Engineering juror Kent Peterson, of P2S Engineering (Long Beach, CA), told SPIE that despite the 1000-square-feet limit on the Solar Decathlon houses, the technologies demonstrated would definitely translate to larger projects.

Continued on page 26

History of Solar Decathlon

Created in 2002 by the US Department of Energy, the Solar Decathlon is an international competition open to universities and institutions of higher education worldwide.

The challenge is: “Design and build a solar house that is energy independent.”

It is held in odd-numbered years in the United States and in even-numbered years in Europe.

The 2014 Solar Decathlon will be held in Versailles, France, 27 June through 14 July.

The first Solar Decathlon in China was held 2-13 August, 2013 in Datong. The top finishers, in order, were University of Wollongong (Australia); South China University of Technology and Huazhong University of Science and Technology (China); and Chalmers University of Technology (Sweden).
“Commercial facilities have similar requirements,” he said. They need to heat and cool by using passive technologies to get passive heating in the wintertime and passive shading in the summertime to reduce the cooling load on the buildings.

“The integration of the solar into the buildings really applies on a larger scale,” Peterson added, “not only to buildings but even facilities like colleges and universities with multiple buildings. You can integrate these technologies with good, efficient design.”

Hands-on learning

Student teams consisted of multidisciplinary groups of graduates and undergraduates. PhD student Sabrina Novalin, team engineer for the first-place Austrian entry, said that the different cultures of architects and engineers could sometimes clash.

“You always have to struggle with architects; I think that’s inherent in this kind of design challenge. Different things that are important to one person are not so important to the other person,” she said. Yet, “it’s been really cool to actually apply all the things you learned in school and put them in the great picture. To approach the entire project in this holistic way, it gives you a really good overview afterwards to get a feeling of what’s in the market and where the trends are going in the industry.”

SPIE student member Kimberly Hammer was the lead designer of the solar thermal system for the Team Las Vegas house, DesertSOL. She described her project in a video for SPIE on the Photonics for a Better World blog: spi.org/blog1017.

The 60 evacuated tubes heat and circulate hot water to the home for showers and other plumbing fixtures as well as space heating via a radiant hydronic flooring system. Besides a 6.75-kW rooftop photovoltaic system, the DesertSOL house sports a unique photonics-based feature: a patio screen laser-etched with an image of a mesquite tree, the only tree native to the Mojave Desert.

“We took that image, converted it to grayscale, and the percentage of gray within each pixel determined the diameter of the hole that was laser-cut,” Hammer said. “We’re really proud of those screens. They cast a nice mesquite-tree shade over the patio when you’re sitting there, so it’s very comfortable.”
Energy patents increasing
Growing markets for renewable-energy technology

A new study from Massachusetts Institute of Technology (MIT) and the Santa Fe Institute (SFI) shows that a modest increase in research and development investment coupled with growing markets worldwide fueled a dramatic increase in the number of patents for renewable-energy technologies over the last decade.

“People have been quite surprised,” says Jessika Trancik, an assistant professor at MIT and co-author of the report, “Determinants of the Pace of Global Innovation in Energy Technologies.”

Trancik, Luís Bettencourt of SFI, and Indiana University graduate student Jasleen Kaur created a database of energy-related patents in more than 100 countries between 1970 and 2009, roughly 73,000 patents overall. The increase was most dramatic in renewable-energy patents, mainly solar energy and wind. China is the leading nation, followed by Japan and the United States.

Between 2004 and 2009, the number of solar- and wind-energy patents worldwide grew 13% and 19% per year, respectively. The number for all energy-technology patents was 11.9%.

Overall, renewable-energy patents in the United States increased from fewer than 200 per year from 1975 to 2000 to more than 1000 annually by 2009. By comparison, there were about 300 fossil-fuel-related patents in 2009, up from about 100 a year in earlier decades.

Winners of 10 contests

Winners of the 10 Solar Decathlon categories were:
- Affordability – Stanford, Norwich, Kentucky/Indiana (tie)
- Appliances – University of Southern California
- Architecture – Czech Republic
- Comfort Zone – Santa Clara
- Communications – Austria
- Energy Balance – All 19 teams tied
- Engineering – Ontario
- Home Entertainment – Santa Clara
- Hot Water – Stevens, Austria, Middlebury, Las Vegas, Alberta, Ontario (tie)
- Market Appeal – Las Vegas

After the event, some of the houses are sold to recover costs or raise money for future teams. Most of the houses, however, are used for research and are put on display to raise awareness about sustainable design.

Team Capitol DC’s Harvest Home will be donated to Wounded Warrior Homes, to be used as a transitional residence near San Diego, CA, for a returning veteran from the US war in Afghanistan.

Asian filings ‘taking off’

The authors also found dramatic growth over the last few years in the number of renewable-energy technology patents in China, which is now a close second to Japan for wind patents. China now files more energy patents per year than Europe and is growing much faster than any other nation. The country also files more patents related to coal technologies than any other nation.

“China’s really taking off,” Trancik says.

Japan is the leader in terms of total patents filed for all energy technologies except coal, hydroelectric, biofuels, and natural gas. Europe has shown a downturn in fossil fuel patents over the last decade, particularly in coal.

The authors conclude that the trends contradict a picture of energy-technology patents driven by public R&D investment and instead point to the opportunities in growing markets that drive an increase in both R&D funding and other forms of investment that generate innovative activity.

The research, published in October 2013 in the Journal PLoS ONE, was supported by the US Army Research Office, the Los Alamos National Lab, the National Science Foundation, and the Solomon Buchsbaum Research Fund.

—Virginia Cleaveland, SPIE staff

Visitors waiting to tour InSite, the house built by Middlebury College students featuring a green roof and reclaimed barn wood exterior. The exterior solar path replaces the traditional rooftop array to create an exterior walkway shaded by solar panels.

Peterson said the move to Irvine was “phenomenal” for the Solar Decathlon, although attendance estimates were lower than for previous years in Washington, DC. Besides having more sun, “California’s a great environment,” he said. “The people who live in California are very married to environmental goals, and California really leads the world in some of the legislation, not only for climate change, but also for energy-efficient design of homes and commercial buildings.”

Since the first competition in 2002, the Solar Decathlon has provided unique training to approximately 17,000 students, preparing them to become innovators and entrepreneurs in clean energy technology and efficient building design.

The competition also shows consumers first-hand how to save money and energy with affordable clean-energy products that are available today.

The next Solar Decathlon in the United States will be in 2015. Dates and location have yet to be determined.

—Rich Donnelly is the managing editor of the SPIE Newsroom and a producer for SPIE.TV.
New spectrometer standard published

When it comes to detectors for dangerous chemicals, toxins, or nefarious germs, smaller and faster is better. But size and speed must still allow for accuracy, especially when measurements by different instruments must give the same result.

The recent publication of a new standard for Raman spectrometers provides confidence that results from handheld chemical detectors can be compared, apples-to-apples.

Emergency responders use such detectors to check for the presence of explosives or toxic chemicals that threaten public safety. Quality control managers in the pharmaceutical industry use them to verify the identity of chemicals going into production lines.

The new standard, published recently by ASTM International, is a culmination of years of research at the US National Institute of Standards and Technology (NIST).

The standard is intended as a guide to correct the differences in peak intensities reported for the same sample by different Raman spectrometers.

“Our goal is that people get the same answer for the same sample on any machine,” says NIST chemist Steven Choquette, whose team developed a series of NIST Standard Reference Materials to correct Raman systems with differing excitation lasers.

Innovations in wearable computing, sensors, and satnav win EU contest

Two German companies innovating with wearable computing devices have won big in the 2013 European Satellite Navigation Competition, an annual contest recognizing the best products and services that use satellite navigation in everyday life.

German startup Kinexon in November won the Galileo Master prize with a small motion sensor worn by athletes to provide accurate, real-time information on an athlete’s condition and position.

The wearable tracking device, which can provide instant measurements on performance, fitness levels, energy consumption, training load, and other activities, may have applications in healthcare as well.

Kinexon founders Oliver Trinchera and Alexander Hüttenbrink edged out more than 400 entries in the competition with a device based on a small sensor cell that offers precise localization and tracking. Accurate to about 10 cm and updated 20 times a second, it captures even rapid movement.

The cell combines real-time improved satnav with information from internal inertial sensors. The satnav technique increases the precision of position data from the Galileo, GPS, and Glonass satellite constellations by using the phase of the signal’s carrier wave, rather than the satnav signal information content itself.

The cloud-based solution for analyzing and visualizing training data on mobile devices could also be used for round-the-clock monitoring of elderly or sick patients as well.

Good vibrations

The competition’s European Space Agency (ESA) Innovation Prize went to entrepreneur Jan Walter Schroeder and his Sensovo team working on a commercial wearable tactile navigation system.

Navipal is a smartphone app with a waist belt that guides the wearer via vibration. The app uses the phone’s internal GPS receiver for positioning and communicates via Bluetooth with the belt.

The belt provides tactile navigation by vibrating one or more of eight motors in the target direction. The vibration intensity and duration changes according to the distance to the next destination point.

Kinexon was supported by the ESA’s Business Incubation Centre, and Sensovo will receive support from the center to continue developing Navipal.
Sunshine in a suitcase

For the last six years, CNN has honored 10 people from around the world as CNN Heroes of the year. These are people working to make a difference through various projects such as cleaning up polluted environments, providing housing for the poor, and bringing produce to “food deserts.”

One of the 2013 Top 10 CNN heroes, Laura Stachel, co-founder of WE CARE Solar, is making the world better through photonics. Stachel’s organization developed the “Solar Suitcase” to provide light to healthcare clinics that face chronic power shortages in developing countries.

Babies born in darkness

In most western countries, childbirth is an event to be celebrated, but people in many African cultures say, “When you become pregnant, you have one foot in the grave.” In the Republic of Malawi, the Chichewan word for pregnancy, “pataki,” means “between life and death.”

According to a 2010 World Health Organization report, almost 99% of pregnancy-related deaths occur in Africa and Asia, with more than half of those deaths occurring in sub-Saharan Africa.

In 2008, Stachel, a US obstetrician based in California, traveled to Nigeria for doctoral studies. At the time, Nigeria had one of the highest maternal mortality rates in the world. While observing an emergency cesarean at a state hospital, the lights suddenly went out. Stachel was surprised by the nonchalant attitude of the staff for whom this was a common occurrence. The procedure was completed by the light of Stachel’s own flashlight.

Stachel learned that power outages are common in African hospitals, and many clinics are without any electricity altogether. Midwives in Nigeria have long resorted to using kerosene lanterns, candles, or even cell phones while delivering babies. Stachel knew these methods were not efficient during delivery complications where direct light was needed.

“I realized my skills as an obstetrician were useless without light and electricity,” Stachel told CNN. “Once I witnessed the situation, I had to do something about it and let people know the conditions facing women giving birth.”

Traveling “light”

Stachel asked her husband, Hal Aronson, a solar-energy educator, to design an off-grid solar electric system for use in maternity wards and operating rooms. She asked for a demonstration kit easy enough for her to use and small enough to fit into her suitcase so she could get through customs without raising suspicions. So Aronson designed a prototype of a larger system that would eventually be installed.

The bright yellow “WE CARE Solar Suitcase” encloses a complete solar electric system, including two solar panels, a sealed lead-acid battery, a charge controller, and two acrylic-encased LED lights. The suitcase also contains outlets to charge cellphones and a fetal heart-rate monitor. The “plug and play” system is easy to operate and is designed to withstand heat, rain, and rough treatment.

Improving maternal health

The Nigerian hospital used the Solar Suitcase until a larger solar electric system was installed. One year after the installation, the hospital reported a 70% decrease in maternal deaths. Requests for solar lighting soon came in from surrounding clinics with similar lighting problems.

Since then, requests have come from around the world and more than 400 clinics now use the portable power kit.

Health workers report improvements in patient care and an increase in women seeking skilled care in rural health facilities.

Although Stachel’s original plan was to meet the needs of women and newborns, community centers, orphanages, and refugee camps have also requested the Solar Suitcase.

The units were used by medical teams after the 2010 Haiti earthquake and the 2013 typhoon that ravaged the Philippines. According to Stachel, “we’re really just on the tip of an iceberg.”

―Karen Thomas, SPIE staff.

The WE CARE Solar Suitcase

The Women’s Emergency Communication and Reliable Electricity (WE CARE) Solar Suitcase was designed in 2008 to provide lighting solutions for maternal health clinics in Nigeria.

The brainchild of Laura Stachel and Hal Aronson, the suitcase was meant to serve as a model for a larger solar power system. The portable suitcase proved so useful, especially in rural areas, that requests for the small units began pouring in.

At first, Aronson assembled the units with help from students and volunteers, but as demand increased, Stachel and Aronson realized they needed to step up production on a larger scale.

They founded the non-profit WE CARE Solar and began applying for grants to help fund production by a California manufacturer.

To date more than 400 units have been delivered, and plans are underway to expand production and update the system as needed.

Destiny in OPTICS

SPIE President H. Philip Stahl says he was destined to be an optical engineer.

SPIE Fellow H. Philip Stahl, the 2014 SPIE president, is senior optical physicist at NASA Marshall Space Flight Center where he leads an effort to mature technologies for a new large-aperture UV/Optical/IR telescope to replace Hubble. Previous assignments include Astrophysics Division deputy assistant director for technology and mirror technology lead for the James Webb Space Telescope.

He is a leading authority in optical metrology, optical engineering, and phase-measuring interferometry. Many of the world’s largest telescopes, including the Keck, the Very Large Telescope, and Gemini, have been fabricated with the aid of high-speed and IR phase-measuring interferometers he developed.

Stahl has a BA in physics and math from Wittenberg University and earned MS and PhD degrees in optical science at University of Arizona.

We asked Stahl to discuss his career path and his interests in science.

Tell us about where you grew up, your family, and your childhood hobbies and interests.

I grew up the oldest of three siblings on a pig farm outside the small town of Bellevue, Ohio, about halfway between Cleveland and Toledo and about seven miles south of Lake Erie. I had many chores – ranging from feeding the pigs to ‘topping’ grain bins. When not cleaning manure out of pig pens, I was either exploring the woods and meadows with my dog, excavating multi-level straw-bale castles in the barn, or reading hundreds of books at the local library.

In junior high school, I went to the library every day after school to do my homework. My childhood activities (which are still some of my favorite activities) were music, scouting (Boy Scouts of America), and science.

What interested you in a career in science?

According to my mother, I was always interested in science and made my grandfather read aloud over and over again books about dinosaurs, stars, and planets. The only scientist I knew was my Uncle Charlie who had a PhD from Case Western Reserve University and was involved with the development of the heart lung machine used for cardiopulmonary bypass surgery. It was not until I got to college, though, that I learned it was possible to actually have a career in science.

I was probably always destined to be an optical engineer. In elementary and middle school, I was fascinated with photography.
and had a Brownie camera. In 6th grade, I read Einstein’s Theory of Special Relativity for a book report and tried to explain it to my father on our weekly car rides home from band practice. As a result, he took me out to the back fence one day and made me promise that I would never become a farmer.

In 9th grade, with help from my father, I tried — unsuccessfully – to build a laser for a science fair project.

I used gift money from my high-school graduation to buy a used Minolta XE-5 camera to take to college. I learned how to load and develop my own film and print my own pictures. Until I got a summer job at Wright-Patterson Air Force Base (WP-AFB) between my junior and senior year at Wittenberg University, my goal in life was to be a high-school physics teacher. That summer job changed my life.

My life changed again just a few weeks into my senior year when a Wittenberg physics professor, M. Paul Hagelberg, learned during his summer job at the Naval Research Lab that there were two US graduate schools for optical engineering (at universities in Arizona and Rochester).

What led you to the field of optical metrology?

As a graduate student at the University of Arizona (UA) Optical Sciences Center, I had done well in the Fourier Optics class taught by Jack Gaskill (1995 SPIE president) but was struggling with Roland Shack’s optical design class and the radiometry course taught by William Wolfe (1989 SPIE president). I found quantum and the courses in electricity and magnetism to be just brute force mathematical drudgery.

I was seriously thinking about stopping with a master’s degree. Then I took two classes from Jim Wyant (1986 SPIE President) on Interference and Interferometry and Optical Testing, and I discovered my bliss.

I discovered mathematics that were elegant and concepts that were intuitively obvious. And, I found that I had an innate ability to do the hands-on lab skills. I switched paths to interferometric optical testing and never looked back.

How did you come to work at NASA?

The arc of my professional career is simple. First, I spent five years at UA discovering and learning the theoretical/academic underpinnings of interferometry, optical testing, and optical system design. Then I spent five years at Breault Research Organization designing, building, and writing the software to operate infrared and visible phase-measuring interferometers and scatterometers. This experience taught me how interferometers and phase-measuring analysis software worked.

Next, I spent four years teaching interferometry and optical testing at Rose-Hulman Institute of Technology (RHIT). The best way to learn and understand a topic is to teach it. My time at RHIT allowed me to consolidate and formalize my knowledge.

Also, I discovered that I love students. I truly enjoy being around smart, inquisitive people. Advising and being responsible for the 15 members of the class of 1993 made me a better person.

Then I spent six years at Hughes/Raytheon Danbury Optical Systems using phase-measuring interferometers and other metrology tools to manage the manufacture of and perform the testing of optics such as the Spitzer Space Telescope secondary mirror and the four-meter, seven-segment Large Active Mirror Program (LAMP). This practical application experience was invaluable. It is one thing to have a theoretical understanding of a subject. It is entirely different to apply that understanding to solve real-world problems.

Finally in 1999, NASA offered me the opportunity to work on the Next Generation Space Telescope, which became the James Webb Space Telescope. They needed someone to lead the effort to develop the technology to manufacture and test the primary mirror segments. It was an opportunity I could not refuse.

Who has made an impact on your career success?

I am the product of numerous role models and mentors who set good examples and gave of themselves. In junior high, my science role model was an older boy in my Scout troop who had built his own telescope and converted an old silo into an observatory. If I had been successful in making my laser, we were going to use his telescope to bounce it off the moon. That boy is now Dr. Mark Wagner of the UA Steward Observatory.

My high-school physics teacher Mr. Meyers challenged me with extra experiments, encouraged me to study physics in college, and was a role model to emulate. I planned to become a high-school physics teacher and I even did a student-teaching practicum in his classroom. But that all changed when, thanks to the base commander at Wright-Patterson AFB (a colonel whose name I don’t even know) took a personal interest in me and arranged for me to have my first optics job working with Vince Chimelis at the optics branch of the WP-AFB Aeronautical Lab. It was Vince who first told me that I was doing a great job and hired me for the entire year.

Dr. Hagelberg at Wittenberg encouraged me to go to graduate school to study optics. He had been my waves instructor and thought I might have an aptitude for optics. Unlike several of my other professors, he thought I could be successful in grad school.

At Arizona, Dr. Fred Bartell went out of his way to convince me that I was PhD quality. And David Markle, Dick Babish, and Frits Zernike not only gave me my first optical engineering and testing summer job, but they told me that I was good and gave me the confidence to continue my studies.

Bob Parks and Achiem Leistner kept me sane as I worked to finish my PhD research. Glenn Boreman and Jim Harvey were great friends and sounding boards. And I have had three great supervisors who always placed the needs of employees above their own: Robert Harned, Victor Bennett, and W. Scott Smith.

Then there is SPIE. SPIE has been the village, the community in which I have come of age. SPIE is my professional family. SPIE is where I make and renew my personal and professional friendships.

For helping me become active in SPIE, credit goes to Sue Davis, the former director of SPIE meetings and exhibitions; Terry Montonye, a former technical director at SPIE; Kevin Harding, the 2007 SPIE president; and Bob Fischer, the 1984 SPIE president.

Finally, there is my wife, Karen. She is my emotional rock upon which the foundation of my professional career is built. ■
2014 SPIE Leadership

The following officers and directors will serve as SPIE’s leaders in 2014. 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.

President
H. Philip Stahl
NASA Marshall Space Flight Center (USA)

Immediate Past President
William Arnold
ASML USA (USA)

President-Elect
Toyohiko Yatagai
Utsunomiya University (Japan)

Vice President
Robert Lieberman
Intelligent Optical Systems, (USA)

Secretary/Treasurer
Brian Lula
Physik Instrumente LP (USA)

Executive Director
Eugene G. Arthurs
SPIE (USA)

Directors

David Andrews
University of East Anglia (UK)

John H. Bruning
Retired, Corning (USA)

Ron Driggers
St. Johns Optical Systems (USA)

Marisa Edmund
Edmund Optics (USA)

Michael T. Eismann
Air Force Research Lab (USA)

Judy Fennelly
Air Force Research Lab (USA)

James Fujimoto
Massachusetts Institute of Technology (USA)

Maryellen Giger
University of Chicago (USA)

Christophe Gorecki
FEMTO-ST (France)

John Greivenkamp
University of Arizona (USA)

James G. Grote
Air Force Research Laboratory (USA)

Keith Lewis
Sciovis (UK)

Anita Mahadevan-Jansen
Vanderbilt University (USA)

Seung-Han Park
Yonsei University (South Korea)

Demetri Psaltis
Ecole Polytechnique Federale de Lausanne (Switzerland)

Kathleen Richardson
University of Central Florida (USA)

D. P. Tsai
Academia Sinica (Taiwan)
SPIE Student Chapters active and growing

SPIE now has a total of 238 Student Chapters, having added 26 chapters and clubs in 2013 at schools such as Johns Hopkins University and University of California, Irvine in the USA; Utsunomiya University (Japan); Institute FEMTO-ST (France); and École Polytechnique Fédérale de Lausanne (Switzerland).

SPIE Student Chapters and clubs are located in 47 countries around the world and are composed of more than 6400 students who participate in education outreach, professional development, and leadership in optics and photonics throughout the year.

Three of the 238 SPIE Student Chapters marked 10 consecutive years of active participation in 2013. Chapters at the Instituto Tecnológico y de Estudios Superiores de Monterrey (Mexico), Pennsylvania State University (USA), and Wroclaw University of Technology (Poland) joined 17 other SPIE Student Chapters with at least 10 years in the program that began in 1997.

The SPIE Student Chapter at University of Central Florida (USA) claims the record, at 16 years, for most years of having at least 10 members and filing annual reports.

Other chapters that have reached the 10-or-more-years milestone at the end of 2013 are based at:

- Bauman Moscow State Technical University (Russia)
- Chernivtsi National University (Ukraine)
- Institute for Atomic Physics (Romania)
- Kent State University (USA)
- Lomonosov Moscow State University (Russia)
- N.G. Chernyshevsky Saratov State University (Russia)
- National Research University of Information Technologies, Mechanics and Optics (Russia)
- National Technical University of Ukraine (Ukraine)
- Nicolaus Copernicus University (Poland)
- Taras Shevchenko National University of Kyiv (Ukraine)
- Taurida National V.I. Vernadsky University (Ukraine)
- Three Rivers Community Technical College (USA)
- Tsinghua University (China)
- Universidad de Buenos Aires (Argentina)
- Vinnitsa National Technical University (Ukraine)
- Warsaw University of Technology (Poland)

Members of SPIE Student Chapters are encouraged to attend one of two annual Student Chapter Leadership Workshops that SPIE organizes.

The workshops scheduled for 2014 will be held Sunday, 13 April, during SPIE Photonics Europe in Brussels and Saturday, 16 August, just before SPIE Optics + Photonics in San Diego, CA (USA).

SPIE offers travel grants for chapter officers who attend the leadership workshops. The application deadline for a grant to the Europe workshop is 15 January.

More information: spie.org/students.
Dali in holographic space

By Selwyn Lissack

Images courtesy of Selwyn Lissack and the Dali Museum, St. Petersburg, FL.
A collaboration of art and science

To understand the dynamics of Salvador Dali’s great achievements in holography, which led to the n-dimensional moment of rock star Alice Cooper’s brain floating in a volumetric holographic space, hearken back to the 1940s when the idea of coherent interference came to be.

In 1947, Hungarian born scientist Dennis Gabor delivered a paper on the recording of three-dimensional space on a two-dimensional surface. Gabor’s invention and development of the holographic method earned him the 1971 Nobel Prize in Physics and the title, ‘Father of Holography.’

Gabor had developed the idea one day while sitting on a tennis court, contemplating the recording of the interference of light in 3D space. As there were no lasers at that time, he proved that the concept worked by using a mercury arc lamp with a very short coherence length. The results showed, indeed, that the refined light from the arc had recorded a 3-mm-deep replication of a wavefront of coherent light.

Although this set the scientific community on fire, the first display hologram could not be made until after the first laser was demonstrated in 1960. Unlike the mercury arc, when the image was recorded with the laser, it created depths of up to a meter or more on the Z axis, depending on the coherence length of the laser.

In those early days, holographers were mainly interested in the technical aspects of holography such as recording small inanimate objects, creating head-up displays for aircraft, and nondestructive testing of parts.

In the late 1960s, our company, International Holographic Corp., in alliance with McDonnell Douglas, produced and marketed the first commercial holographic products from a 3D, artistic point of view. The holograms and their history can be seen at bit.ly/daliLissack.

The possibilities for holography seemed endless. With each new product, we were closer to achieving our artistic goals.

Meeting Salvador Dali

Yet we knew in order to introduce holography to the world as an art medium, we would need a well-known artist who could understand the technical aspects of holography. I had been fascinated with Salvador Dali since I was child. His obsession with finding and creating in other dimensions and his great understanding of three-dimensional symmetry and perspective on a flat plane made him the perfect choice.

I was living in New York in 1971 when I learned that Dali was staying at the St. Regis Hotel. So, I decided to pick up the phone and give him a call. At the last minute, I handed the phone to my friend George Besch, thinking my South African accent might be hard for the great surrealist artist to understand.

Never in my wildest dreams did I think we would be speaking to the legendary Dali himself, and the very next day we were actually sitting in his suite, talking to him about holography.

Dali was thrilled with the notion of working with a medium which gave him the ability to create beyond the confines of linear space, and his hotel suite became our office. Over the next five years, we met often to discuss the many ideas he wanted to explore. From 1971 to 1976, Dali and I collaborated to produce seven holographic works of art, which were to become some of the most important art holograms of the 20th century.

They were:
- Brain of Alice Cooper
- Crystal Grotto
- Dali Painting Gala
- Holos! Holos! Velázquez! Gabor!
- Submarine Fisherman
- Polyhedron
- Melting Clock

The last one, the Melting Clock hologram, was conceived in 1975 but not constructed until 2003 when LED technology made the playback system more practical.

Technology for art holograms

When the Dali holograms were made, holography was in its infancy and had many limitations and challenges. The details of the making of all the Dali holograms can be found in the 2012 book, Dali in Holographic Space, which I wrote with Linda Lissack. (bit.ly/DaliHologram)

Dali’s contributions to art holography were monumental. His talents and forward-thinking mind were so far ahead of the technology that the artwork he applied in creating the holograms would be exactly the same today. The Dali holographic masters can be compared to currency plates; they transcend time and they never change. What does change, with evolving technology, is the playback system.

How did Dali learn of holography?

“Always believing that physics and metaphysics would lead to an understanding of life and our connection to the universe, he eagerly entered into the magical world of holography.”

– From Dali in Holographic Space

Dennis Gabor

SPIE Award

SPIE has presented the Dennis Gabor Award for outstanding accomplishments in diffractive wavefront technologies each year since 1983. The award honors the 1971 Nobel laureate and his invention and development of the holographic method.

David J. Brady of Duke University (USA) received the 2013 award for his development of compressive holographic and tomographic imaging systems and for advances in the physical and information science of imaging and spectroscopy.

Nominations for an SPIE Award may be made through 1 October of any given year and are considered active for three years from the submission date.

More information: spie.org/gabor

Continued on page 36
Dali in holographic space

Continued from page 35

In the 1960s and ’70s, and even still today, bulky, hot, expensive lasers, mercury-arc, and tungsten halogen lights have been used to play back holograms. Unfortunately, none of these systems work well in the home, making it difficult to display a hologram in an artistically inspired manner.

With the invention of “super-bright” LEDs, however, art display holograms in the home may be in our future.

A super-bright LED is a good point-source light for holography. These LEDs are available in various colors or white light, use very little power, and have a 1-inch Edison screw-in base, similar to the average light bulb for the home. LEDs run cool and can have a life of more than 30,000 hours.

Dali’s artistic vision

As we evolve into a digital world, with holographic printers, I often wonder what Dali, who died in 1989, would have done with the new technology. Can you imagine Dali sitting down to a three-dimensional CAD-type program to paint a 3D picture?

As he once said, “Art is only limited by one’s imagination.”

It was a humbling experience working with such a great mind and artist as Dali. I have spent my life fulfilling the promises I made to him. This was to create and produce his holographic images with the evolving technology, as he envisioned them.

Dali Painting Gala (1)

Dali Painting Gala is a 360-degree auto holographic stereogram. It is an intricate blending of images, creating a multitude of changing angles between the many objects and perceived symbolic metaphors. Conceived in 1976, the 10- by 18-inch diameter piece is a white light “Benton” transmission rainbow hologram.

Submarine Fisherman (2 & 8)

Inspired by Sigmund Freud’s interpretations of the murky waters of the subconscious mind, the Submarine Fisherman is a mixed media display. Dali created multi-dimensions by combining a transparency of Picasso’s The Young Ladies of Avignon with a transmission hologram (on which he had painted the face of a Catalonian girl). The challenge to create the Submarine Fisherman was to light both the hologram and the transparency at the same time. Conceived in 1971, the Submarine Fisherman is in a private collection.

The Crystal Grotto (3)

The Crystal Grotto, a gateway to heaven, is a 3D holographic collage. It is a shrine to Dali’s spiritual belief, a place of magic where the particles of the universe come together, creating a sacred, holy place. Conceived in 1971, the Submarine Fisherman is in a private collection.

Call for papers

The November 2014 issue of the SPIE journal Optical Engineering will have a special section on new techniques and applications of holography.

Manuscripts for “Practical Holography: New Procedures, Materials and Applications,” are due 1 February.

SPIE Fellow Pietro Ferraro of CNR, Instituto Nazionale di Ottica (Italy) and SPIE member A. R. Ganesan of the Indian Institute of Technology Madras are guest editors.

More information: spie.org/oe

Holography events at Photonics West

A holography technical event, poster session, and a conference on practical holography will be part of OPTO at SPIE Photonics West in February.

SPIE Fellow Hans I. Bjelkhagen of Glyndwr University and Hansholo Consulting (UK) will chair the holography technical event at 7:30 pm 4 February and co-chair the Practical Holography: Materials and Applications conference 3-5 February.

The technical event will focus on recent developments on new materials, color display holography, digital holography, computer-generated holograms, and holographic optical elements.

--Selwyn Lissack (above, left) is a 3D artist, jazz musician, and entrepreneur who co-founded the New York School of Holography and the Holographic Design Development Co., which later became International Holographic Corp. In 1981, he became president of Laserworks. He has been awarded several patents for laser-scanning technology. The Dali Theatre-Museum in Figueres (Spain) and the Dali Museum in St. Petersburg, FL (USA), maintain collections of various Dali holograms, as do private collectors. For more information on Lissack’s book on Salvador Dali: bit.ly/DaliHologram.

Dali Painting Gala (1)

Dali Painting Gala is a 360-degree auto holographic stereogram. It is an intricate blending of images, creating a multitude of changing angles between the many objects and perceived symbolic metaphors. Conceived in 1976, the 10- by 18-inch diameter piece is a white light “Benton” transmission rainbow hologram.

Submarine Fisherman (2 & 8)

Inspired by Sigmund Freud’s interpretations of the murky waters of the subconscious mind, the Submarine Fisherman is a mixed media display. Dali created multi-dimensions by combining a transparency of Picasso’s The Young Ladies of Avignon with a transmission hologram (on which he had painted the face of a Catalonian girl). The challenge to create the Submarine Fisherman was to light both the hologram and the transparency at the same time. Conceived in 1971, the Submarine Fisherman is in a private collection.

The Crystal Grotto (3)

The Crystal Grotto, a gateway to heaven, is a 3D holographic collage. It is a shrine to Dali’s spiritual belief, a place of magic where the particles of the universe come together, creating a sacred, holy place. Conceived in 1971 and commissioned by Eleanor and Reynolds Morris, the Crystal Grotto is a 4- by 5-inch transmission hologram.
The Brain of Alice Cooper

The Brain of Alice Cooper is a 360-degree holographic stereogram with the image of rock star Alice Cooper, seemingly floating in the center of the cylinder. A remarkable aspect of a 360-degree holographic stereogram is it also records time, allowing the artist to work in the 4th dimension. The 10- by 16-inch diameter auto holographic stereogram, conceived in 1973, has a motorized turntable.

The Melting Clock

Dali was a true visionary, creating holograms that would transcend time. The Melting Clock was a natural progression of Dali’s work in holography as well as an ongoing exploration of time and space. Conceived in 1976 and produced in 2003, this 18- by 24-inch silver-halide reflection hologram is a concept in recycled molecules of a moment in time conceived in the past. Dali’s Melting Clock hologram could not be constructed in his lifetime because the lighting system used for playback was too hot. The project was reproduced with 21st century technology after his death, in homage to his genius and ability to see beyond the limits of time. He entrusted the blueprint to me before he died in 1989 to complete the project when the technology to create it was available. I was finally able to honor my promise to him with the assistance of a modern holographic lab, Laser Reflections, and a pulsed green ytterbium fiber laser.

Polyhedron

In the Polyhedron hologram, Dali’s objective was to create a multivolume of space. This was accomplished by combining four elements. With the polyhedron’s geometric surfaces, Dali painted basketball players in the process of becoming angels. It also includes a 3-inch sphere of the planet Earth, a portrait of Dali painting his wife and muse Gala in a mirror, and a photograph of Dali as a child. Once Dali was satisfied with the artwork, it was taken to the lab to be recorded. Conceived in 1972, this 18- by 24-inch transmission hologram is in a private collection.

Holos! Holos! Velázquez! Gabor!

Holos! Holos! Velázquez! Gabor! is a complex concept hologram conceived in 1972 showing two completely different moments in time, with two separate realities existing in the same space. To create the hologram, Dali took fragments from two pre-existing works. The final piece, an 18- by 24-inch transmission hologram, would consist of two plates. The first was Las Meninas, an oil painting by Diego Velazquez. The second was a pre-existing hologram of three modern-day men seated at their weekly poker game. The displaying of this hologram required a 150mW green laser, placed 12 to 15 feet behind the plates at a 45-degree angle.

Holography as art medium

Dali in Holographic Space covers the collaboration in the 1970s by Salvador Dali and South African artist Selwyn Lissack to use laser light as paint brush and canvas in order to dabble in the third and fourth dimensions.

Holography “would prove to be the most unique and important artistic medium in which to express Dali’s three-dimensional ideas,” Lissack says.

“No longer confined by the limitation of a two-dimensional surface, holography presented the opportunity for Dali to symbolically recreate his views and perception of other dimensions within our own reality of space.”
Accreditation board approves US optics degree criteria

A

pproval late last year by the Accreditation Board for

Engineering and Technology (ABET) for program

criteria for optics and photonics engineering in

undergraduate degrees was hailed as confirmation that the field

is a critical technology for the 21st century.

Representatives of SPIE led the efforts to define and

recommend degree criteria that meet the needs of both

academia and the optics and photonics industry.

ABET is a federation of 30 professional and technical

societies that acts as the accreditor for US college and university

programs in applied science, computing, engineering, and

technology. The ABET board approved the criteria in October.

“I really believe that this is a key and defining juncture for

our discipline,” said Barry Shoop, professor at the US Military

Academy at West Point and SPIE Fellow, who represents SPIE

on the ABET board of directors.

Shoop, who received the 2013 SPIE Educator Award for his

work with ABET, stressed that the approval was “a massive

team effort.” He singled out SPIE Fellow Charles Joenathan

and SPIE member Robert Bunch, professors from Rose-Hulman

Institute of Technology, who first encouraged SPIE to become

engaged in ABET.

ABET approval for optical and photonics engineering as its own

field makes possible a greater awareness of the critical role of optics

in society, said SPIE Senior Member Carl Maes, an associate dean

at the University of Arizona College of Optical Sciences.

“The existence and value of a bachelor’s degree in optical

engineering has been largely overlooked,” Maes said. “It has

been this way in spite of the fact that most people depend upon

technology enabled by optics every day of their lives.”

Maes added that he was hopeful the next generation of engineers

“will more effectively see optics and photonics engineering as a

viable and attractive option for an accredited college degree, which

they can pursue to help make the world better.”

Florida college to establish laser and fiber optics center

I

ndian River State College (IRSC) in Florida (USA) is using

a $2.9 million National Science Foundation grant to establish

a Lasers and Fiber Optics Regional Center to meet America’s

urgent need for skilled laser and fiber-optics technicians.

Workforce projections identify a need for more than 1500

specialized technicians in the US, while the current output of

US colleges is about 350 each year.

In partnership with a network of 10 colleges and more than 253

companies, IRSC will lead a regional initiative to train technicians

to repair and maintain equipment such as MRIs and telephone

processing systems that have lasers or fiber optic sensors.

The program will serve as a gateway to high-skill, high-wage

employment in new industries after two years of technical training.

“Training in lasers and fiber optics opens doors in new high-

tech manufacturing, providing the skills needed for advancement

in the 21st Century, much as traditional manufacturing

expertise was a valuable asset in the past,” said SPIE member

Chrys Panayiotou, IRSC professor of electrical

engineering and principal investigator for

the grant.

“Knowledge of lasers and fiber optics

will provide unprecedented opportunities

as these technologies expand,” he said,

and “support development of new products, companies, and a

strong economy.”

IRSC is a partner of OP-TEC, the NSF/ATE National Center

for Optics and Photonics Education, in the development

of training modules in optical imaging and solar energy

technology. IRSC is also collaborating with Corning

Fiber Optical Systems for training in the latest fiber optic

technologies.

“IRSC’s successful partnership with industry leaders at

the state and national level was an important factor in our

attainment of this competitive grant,” said Edwin R. Massey,

IRSC president.

The need for job-training programs in photonics, and lasers

in particular, was a key recommendation of the National

Photonics Initiative (NPI), which was launched in 2013.

The NPI is an alliance of industry, government, and academic

representatives seeking to raise awareness of optics and photonics

and drive US funding and investment in five key photonics-

driven fields critical to US competitiveness and national

security: advanced manufacturing, communications and

information technology, defense and national security,

energy, and health and medicine. Founding

sponsors are SPIE and OSA. □
Engineered biomimicry and advanced testing for infrastructure will have a greater role at the annual SPIE Smart Structures + Nondestructive Evaluation (SS/NDE) symposium in San Diego in March.

Along with 10 conferences devoted to nondestructive testing, structural health monitoring, smart sensors, and electroactive polymer actuators and devices (EAPAD), the 21st annual international symposium, 9-13 March, will have sessions on biomimicry and soft-bodied robots in engineering research and practice.

SPIE is partnering with the San Diego Zoo this year to host a panel discussion at the Bioinspiration, Biomimetics, and Bioreplication conference on the current state of bioinspiration in the research lab, its challenges, and future solutions.

A representative from the zoo’s Centre for Bioinspiration will bring an “animal ambassador” to demonstrate how engineers can transfer ideas and capabilities from nature to commercial products, services, and processes that benefit the world.

The panel is open to all attendees and will focus on all aspects of engineered biomimicry, including education, awareness, applications, research, and funding sources.

Five plenary sessions, also open to all attendees, will cover systems for intelligent adaptive fluid-structure interactions, flexible electronics, non-contact sensing techniques, hybrid nanodevices, and other topics.

SPIE Senior Member Hoon Sohn of Korea Advanced Institute of Science and Technology (KAIST) in South Korea will discuss noncontact laser sensing techniques for structural health monitoring and non-destructive testing in his plenary presentation. The techniques are used to monitor and test aircraft, wind turbine blades, nuclear power plants, bridges, semiconductors, and other structures.

Other plenary speakers will be:
- Karlheinz Bock, deputy director of Fraunhofer EMFT in Germany
- Peter Cawley, head of the Department of Mechanical Engineering at Imperial College London
- Gianaurelio Cuniberti, chair of Materials Science and Nanotechnology at Technische Universität Dresden
- Roger Ohayon, professor emeritus at the Conservatoire National des Arts et Métiers (CNAM) in Paris

Interactive EAP session

The event will also include the annual EAP-in-Action session with demonstrations of electroactive polymer materials and opportunities for hands-on interactions. Tentatively scheduled for this year’s session will be a crawling microbot with movement inspired by an inchworm and propelled by liquid-based bending EAPs.

Also scheduled for the popular session are a computer mouse enhanced with dielectric elastomer actuator (DEA) technology to provide tactile feedback into the user's palm; wearable energy harvesters, and soft-sensor technologies such as a wireless glove powered by dielectric elastomer generators.

A high-speed, silicone, DEA-based multigripper, a candidate to be mounted on a Swiss satellite to demonstrate the possibility of orbital debris removal, will also be demonstrated.

Robert Shepherd, assistant professor at Cornell University in New York, is the EAP conference’s keynote speaker. Shepherd will discuss soft-bodied robotics, a field that is creating more sophisticated robotic motions and safer human-machine interactions by taking advantage of compliant actuators and passive dynamics to reduce design, manufacturing, and control complexity and to improve energy efficiency.

Shepherd will also describe his work as a postdoctoral fellow with the Whitesides Research Group at Harvard University (USA), where he developed pneumatic actuators in soft elastomers that took the form of a machine capable of walking, undulating, and moving in multiple gaits. These actuators can be used in concert with a microfluidic system for biomimetic camouflage and display.

Symposium chairs are SPIE members Victor Giurgiutiu of University of South Carolina (USA) and Christopher S. Lynch of University of California, Los Angeles (USA). Co-chairs are Theodoros E. Matikas, professor at University of Ioannina (Greece), and SPIE member Jayanth N. Kudva of NextGen Aeronautics (USA).

For more information about this year’s event, visit spie.org/ssnde.
More technology transfer at Photonics West 2014

SPIE Photonics West, 1-6 February in San Francisco, with more than 4600 technical papers on all aspects of theoretical and applied photonics, will have an increased focus on helping applied photonics research transfer into commercial applications.

Along with well-established technical conferences in biomedical optics, optoelectronics, lasers, MOEMS-MEMS, and green photonics, Photonics West will feature an expanded industry and business conference track with free, business-focused workshops and panel sessions aimed at photonics technology transfer.

In addition to annual events such as the Prism Awards for Photonics Innovation and the SPIE Startup Challenge, industry sessions will cover US export controls, intellectual property, marketing of photonics technologies, and financing of life-science and healthcare ventures.

An “accelerator forum” aimed at photonics startups will be held as well as a keynote talk on the economic impact of photonics and a technology transfer showcase hosted by SPIE Fellow David Wick, Sandia National Labs’ licensing executive.

Photonics West will also feature two exhibitions at the Moscone Center with more than 1300 companies, 70 professional development courses, a free Job Fair, and a virtual symposium within BiOS dedicated to translational biophotonics research.

Sunny projections for solar

Among events in the new conference track for industry and business is a green photonics panel moderated by SPIE Fellow Stephen Eglash, executive director of the Energy and Environment Affiliates Program at Stanford University (USA), that will focus on what Eglash calls “a solar revolution.”

“The solar industry is stronger than ever,” says Eglash, who also chairs the Green Photonics virtual symposium. “Companies along the photovoltaic food chain have figured out how to make money and disruptive innovations promise a new generation of technologies.”

The energy-generation industry is on the verge of a technological transition that will see solar photovoltaics, “become the main source of new electricity generation over the 2020-2030 period,” according to panel member Martin A. Green of the Australian Centre for Advanced Photovoltaics at University of New South Wales.

Green says the transition will be driven by the decreasing costs of solar energy in an environment where traditional energy source costs are escalating.

Two other panelists discussing growth opportunities and the future of the solar industry are Raffi Garabedian, CTO of First Solar (USA), and Homer Antoniadis, global technology director of DuPont Photovoltaic Solutions (USA).

Commercializing optics

A panel discussion on investing in life sciences and healthcare ventures is also expected to have an upbeat message. Companies in this sector are working to address market challenges with an interdisciplinary mix of technologies and see biophotonics as a key enabling technology, says SPIE Senior Member Linda Smith, president
of Ceres Technical Advisers (USA) who will moderate a panel of representatives from leading investment and venture capital firms.

“Biophotonics is fertile ground for investment and economic growth,” Smith says in the Ceres newsletter. “Public markets aside, the market for private placements in development-stage and high-growth biophotonics businesses is robust.”

The Technology-Transfer Showcase is a new addition to the Photonics West program and will focus on licensing and how the latest research can be transferred into new applications. Representatives from universities and laboratories who are currently seeking commercialization partners will be on hand for the discussion.

“I see the Technology-Transfer Showcase as an opportunity to connect creators with companies,” says moderator David Wick. “Labs and universities are hotbeds of wildly creative ideas. The trick is turning those ideas into cost-effective, reliable products and introducing them to the marketplace.”

Wick says he hopes participants will see these “incredible new technologies, recognize potential market opportunities, and start leading some of us out of the proverbial ‘Valley of Death.’”

Another business-focused workshop designed to instill essential skills for business is “Commercialization of Photonics Technology,” led by SPIE member David Krohn of Light Wave Venture Consulting (USA). Krohn is the author of the SPIE Press book, Commercialization Basics for the Photonics Industry, which covers fundraising strategies, government contracts, marketing and manufacturing basics, and the all-important employee recruitment process for anyone considering starting his/her own photonics business.

(Read more about Krohn’s ideas on photonics commercialization at spie.org/krohnST.)

**BIOS to highlight OCT**

The BIOS symposium, chaired by SPIE Fellows R. Rox Anderson of Massachusetts General Hospital (USA) and James Fujimoto of the Massachusetts Institute of Technology, includes three sessions focusing on understanding the brain through new imaging techniques. A new conference will cover optical elastography and tissue biomechanics.

Technology transfer and translational research will also be a theme at the BIOS Hot Topics sessions.

Facilitated by SPIE member Sergio Fantini of Tufts University (USA), the Hot Topics sessions will highlight advances in optical coherence tomography (OCT) and other biomedical technologies.

Eric Swanson, editor of OCT News, notes that while OCT has matured in some applications, its potential is expanding into many fields. Swanson will discuss the future of the OCT market in “Clinical Translation in OCT: Role of Research, Funding, and Entrepreneurism.”

(For more on OCT, see page 16 and an SPIE Newsroom video on the growth of the OCT market (spie.org/swansonOCT).

SPIE member David Boas of Massachusetts General Hospital will present, “Optical Spectroscopy and Tomography of Oxygen Delivery: From Macro to Micro and Back,” highlighting noninvasive imaging. Boas has been appointed editor of the new SPIE journal Neurophotonics. (Read more about this new journal on page 20.)

SPIE Fellow Bruce Tromberg of Beckman Laser Institute and Medical Clinic (USA) will discuss the development of diffuse optical imaging in breast cancer treatment during his

**Two exhibitions in Moscone Center**

The SPIE BIOS Expo, 1-2 February, features the latest technologies from 210 suppliers in the biomedical optics and photonics industries.

The SPIE Photonics West exhibition, 4-6 February, will include 1200 companies showing components, systems, lasers, and applications for optics, lasers, and photonics manufacturing.

The Moscone Center during SPIE Photonics West will be filled with displays of optical detectors, fibers and materials, cameras and displays, and other innovations.

Both exhibitions are free.  

Continued on page 42
Member events

SPIE membership events at Photonics West will include a members-only dessert reception Tuesday, 4 February, at the ROE restaurant in San Francisco and a presentation on silicon photonics at the SPIE Fellows lunch on Monday, 3 February.

Ashok Krishnamoorthy, chief technologist for photonics at Oracle, is the featured speaker at the SPIE Fellows luncheon. Krishnamoorthy is a member of the Optical Interconnects conference program committee at OPTO, part of SPIE Photonics West.

SPIE will host an informal buffet breakfast for SPIE Senior Members on Tuesday, 4 February.

SPIE members are requested to bring their conference badge, receipt, invitation, or other evidence of SPIE membership to the member reception. Fellows and Senior Members should RSVP to brentj@spie.org for their events and to get times and locations.

EVENTS

Photonics West 2014

Continued from page 41

Hot Topics presentation, Tromberg also serves as chair for the new Translational Research virtual symposium. Some 200 papers submitted to BiOS that show how photonics technologies can help meet current challenges in cancer, heart disease, and neurological disease will be eligible for Translational Research best paper awards.

On Sunday, February 2, Tromberg will also lead a translational research luncheon forum, featuring select speakers from the Translational Research virtual symposium presenting their work in evidence-based medicine.

Other BiOS speakers and their topics include:
- SPIE member Eric Seibel, University of Washington (USA), “Scanning Fiber Endoscopy: Multimodes of Guided Intervention”
- SPIE Fellow Li Hong Wang, Washington University in St. Louis (USA), “Photoacoustic Tomography: Ultrasonically Beating Optical Diffusion and Diffraction”
- Jelena Vuckovic, Stanford University (USA), “Single-cell Photonic Nanocavity Probes”
- Paul Selvin, University of Illinois at Urbana-Champaign (USA), “New Small Quantum Dots for Neuroscience”

New laser applications at LASE

The LASE 2014 symposium, co-chaired by SPIE Fellows Andreas Tünnermann of Fraunhofer-IOF and Friedrich-Schiller University, Jena (Germany), and Bo Gu of Bos Photonics (USA), features the latest research on new laser sources and applications. Program tracks include Laser Source Engineering, Nonlinear Optics, Semiconductor Lasers and LEDs, Laser Micro-/Nanoengineering, and Laser Applications.

International experts on 3D printing, laser additive manufacturing (LAM), and other laser manufacturing technologies and applications will also present papers during several sessions on those topics.

Professionals involved in theory and applications of free-space laser communications, remote sensing, and supporting technologies are invited to participate in an open discussion on laser communications.

LASE plenary speakers are:
- SPIE Fellow Koji Sugioka, RIKEN (Japan), “Femtosecond Laser 3D Micromachining and its Applications to Biochip Fabrication”
- Photonics21 president Michael Mertin, JENOPTIK (Germany), “Photonics21 and the Perspectives from the European Photonics Industry”

Optoelectronics for holography

OPTO 2014 topics include optical interactions, optoelectronic materials, semiconductor lasers and LEDs, solid-state lighting, photonic integration, displays and holography, nanotechnology in photonics, photonics packaging, and optical communications, along with the commercial applications of these technologies.

Technical events include a session in holography chaired by SPIE Fellow Hans I. Bjelkhagen of Glyndwr University and Hansholo Consulting (UK). This session focuses on recent developments in new materials, color display holography, computer generated holography, and holographic optical elements.

OPTO plenary speakers are:
- SPIE member Michal Lipson, Cornell University (USA), “Pushing the Boundaries of Silicon Photonics”
- SPIE member, Ursula Keller, ETH Zurich (Switzerland), “The Previously Unbelievable Performance of Ultrafast Thin Disk Lasers”

Symposium chairs for OPTO are SPIE Fellows David L. Andrews of University of East Anglia (UK) and Alexei L. Glebov, CEO and president of OptiGrate (USA).

MOEMS-MEMS highlights

The MOEMS-MEMS symposium explores how these technologies enable mass-produced miniaturized products and integrated systems. Presentations feature the latest on optical MEMS, biomedical MEMS and sensors, microfluidics, micro-optics, and adaptive optics research.

Symposium chair for MOEMS-MEMS is David Dickensheets of Montana State University (USA). Holger Becker, co-founder of microfluidic ChipShop (Germany), is co-chair. Becker will moderate a panel on “Prospects and Future of Microfluidics,”
EVENTS

featuring discussions on the gains and setbacks made in the product development and marketing phases of microfluidics-enabled devices.

Plenary speakers for MOEMS-MEMS are:

• SPIE member John Rogers, University of Illinois at Urbana-Champaign (USA), “Bio-Integrated and Bio-Inspired Optical Microsystems”

• Roger Howe, Stanford University (USA), “Electrostatic Nano Electromechanical Switches (NEMS) for Energy-Efficient Digital Systems”

• Cornelia Denz, Westfälische Wilhelms-Universität Münster (Germany), “Tailoring Light for Optically-Guided Nano- and Microassembly: From Bio-Hybrid Robots to Droplet Cages”

Events for career help

Photonics West also offers networking opportunities and student events throughout the week.

The SPIE Startup Challenge invites new entrepreneurs to pitch their light-based technology product to a team of business development experts and venture capitalists. Three winners will receive cash prizes and the opportunity to attend a weeklong entrepreneur workshop where they can refine their winning ideas.

JENOPTIK is founding sponsor of the SPIE Startup Challenge. Additional support comes from Edmund Optics, Trumpf, Open Photonics, and IP law company Knobbe Martens.

A panel discussion, “Getting Hired in 2014 and Beyond,” offers tips on seeking employment at tech-based companies and non-academic jobs.

Student events include Lunch with the Experts, a casual meal with optics and photonics experts sharing their career experiences; a student chapter meeting; and a “No Ties” student social.

Leaders from regional optics and photonics clusters are invited to a cluster reception that will include a keynote presentation on the economic impact of photonics.

More information: spie.org/pw.

Prism Awards announced 5 Feb.

The Prism Awards for Photonics Innovation recognize the most innovative technologies in the optics and photonics industry that break conventional ideas, solve problems, and improve life through photonics.

Awards for innovative photonics products, processes, devices, systems, instruments, and technologies that are newly available on the open market will be made 5 February during SPIE Photonics West.

See page 13 for a list of finalists.

Biophotonics in Brazil

In May 2013, SPIE and the São Paulo Research Foundation (FAPESP) sponsored a biophotonics school at the Advanced School on Modern Trends of Biophotonics for Diagnosis and Treatment of Cancer and Microbial Control (Brazil). For nine days, 100 students from 21 countries heard talks on spectroscopy, PDT, microscopy and imaging, microbiological control, and cancer diagnostics.

From that event came the idea of bringing biophotonics research from Brazil to SPIE Photonics West.

Three biophotonics experts from Brazil will do just that at a discussion session and reception on 4 February in San Francisco.

Panel moderator Carlos H. de Brito Cruz, science director of FAPESP, will discuss biophotonics research programs offered by FAPESP, a public foundation that provides grants, funds, and programs to support research, education, and innovation in São Paulo.

Its programs include support of foreign scientists working at research institutions in São Paulo, post-doctoral fellowships, young investigator awards, and visiting researcher grants.

Carlos Lenz Cesar of Universidade Estadual de Campinas will discuss the development of a multimodal photonic microscopy platform and present examples of how this platform is used to observe single-cell processes.

Helena B. Nader of Universidade Federal de São Paulo will highlight research on the drug Heparin and its derivatives in antithrombotic therapy.

GREEN PHOTONICS

The Green Photonics virtual symposium will highlight 200 papers presented at Photonics West on the latest photonics and optoelectronic tools and materials to reduce power consumption, enable cleaner manufacturing, and create new energy generation for a broad range of applications.

Papers from all areas of Photonics West that feature some aspect of green photonics will be eligible for the Green Photonics Best Paper Awards.

Symposium chair is SPIE Fellow Stephen Eglash of Stanford University (USA).
New location for Electronic Imaging

The 2014 IS&T/SPIE Electronic Imaging Science and Technology symposium is moving to a new location at the Hilton San Francisco in California (USA). Held 2-6 February, the symposium will feature more than 650 presentations organized into 20 technical conferences on topics in 3D imaging, digital photography, multimedia processing, mobile displays, computer vision, and related fields.

A new conference, “Measuring, Modeling, and Reproducing 3D Material Appearance,” has been added along with new courses on image and video forensics and computer vision and imaging in transportation applications.

The symposium, jointly sponsored by the Society for Imaging Science and Technology (IS&T) and SPIE, coincides with SPIE Photonics West held at the nearby Moscone Center. SPIE members attending IS&T/SPIE Electronic Imaging at the Hilton are invited to attend the Photonics West member reception and to register for the free Photonics West exhibition.

SPIE Fellow Sergio Goma, senior director of R&D at Qualcomm (USA) is symposium chair, and Sheila Hemami of Cornell University (USA) is co-chair. SPIE member Choon-Woo Kim of Inha University (Republic of Korea) is Short Course Chair. SPIE Fellow Majid Rabbani of Eastman Kodak Co. (USA) is Short Course Co-Chair.

Plenary sessions explore new fields

While some researchers see imaging as a mature field, others see a new phase of innovation occurring as a convergence of technologies enables the creation of a wide variety of imaging systems based on the tight integration of algorithms, computation, and sensor design. This new field, “integrated imaging,” is evolving out of classical imaging modalities.

SPIE Fellow Charles A. Bouman of Purdue University (USA) will present a plenary talk on integrated imaging systems and explore their use and potential impact in applications ranging from healthcare to jet-engine design.

The other plenary speaker, Jack L. Gallant of the University of California, Berkeley, will discuss his research group’s studies of the human brain to determine how reverse engineering the brain might lead to the design of artificial visual systems with the same sophisticated image-processing capabilities of humans. Gallant will describe the use of fMRIs and a data-driven, system-identification approach to tackle the reverse-engineering problem.

Other special events

IS&T/SPIE Electronic Imaging will have several special events, including presentations of recently published material in the Journal of Electronic Imaging (JEI) and a hands-on demonstration on Tuesday, 4 February, of imaging hardware, software, display, and research products.

JEI, co-published by SPIE and IS&T, publishes peer-reviewed papers on a wide variety of imaging related subjects. Authors of recently published JEI articles will present their work in several sessions noted in the program with a special JEI logo. And in a move toward direct presentation-to-journal publication, conferences on digital photography and stereoscopic displays and applications will feature new material soon to be published in JEI.

The popular 3D theater session, part of the Stereoscopic Displays and Applications conference, will screen new, original 3D footage Monday, 3 February. SPIE Fellow and conference co-chair Andrew J. Woods will host the screening and announce the final program at the event.

Keynote speakers are featured in several conferences. Topics include:

• Perceiving, measuring, and modeling 3D material appearance
• Compressive displays
• Human sentiment and emotion in images shared in social media
• Digital coloring books
• Photo forensics
• Digital wallets and mobile payments
• Preventing piracy conversion
• Perceptual tools for quality-aware video networks

More information: spie.org/EI.
If you design telescopes, develop imaging techniques to detect disease, or use light to study the brain, SPIE now has the journal for you.

SPIE will launch the Journal of Medical Imaging (JMI) in early 2014. **Maryellen Giger,** Editor-in-chief

JMI covers fundamental and translational research and applications focused on photonics in medical imaging, which continue to yield physical and biomedical advancements in early detection, diagnostics, and therapy of disease, as well as in the understanding of normal. JMI will be published online and in print, with free access to the online version through 2015.

SPIE.org/JMI

SPIE will launch the Journal of Astronomical Telescopes, Instruments, and Systems (JATIS) in mid-2014. **Mark Clampin,** Editor-in-chief

JATIS publishes peer-reviewed papers reporting on original research in the development, testing, and application of telescopes, instrumentation, techniques, and systems for ground- and space-based astronomy. JATIS will be published online and in print, with free access to the online version through 2015.

SPIE.org/JATIS

SPIE will launch Neurophotonics in mid-2014. **David A. Boas,** Editor-in-chief

At the interface of optics and neuroscience, Neurophotonics covers cutting-edge technological advances and the impact on neuroscience and clinical applications. Neurophotonics will be published online and in print, with free access to the online version through 2015.

SPIE.org/Neurophotonics
SPIE DSS, with two technical symposia, a 500-company DSS Expo, and a free job fair, will be joined in May by conferences from several collocating events, including the Advanced High Power Laser Conferences organized by the Directed Energy Professional Society (DEPS).

Pennsylvania State University's Electro-Optics Alliance (EOA) will hold its annual meeting during SPIE DSS. The MIRTHE (Mid-InfraRed Technologies for Health and the Environment) Engineering Research Center and the Maryland technology transfer organization TEDCO are also planning activities alongside DSS during the week.

The technical program at SPIE DSS, 5-9 May in Baltimore, MD (USA), includes Defense + Security, with 32 conferences, and the newly established Sensing Technology + Applications symposium, with 27 conferences.

Some 2200 papers will be presented on IR, laser, spectroscopic, and other technologies for displays, imaging, cyber sensing, food safety, energy harvesting, oil and gas exploration, and more.

Troy Meink, deputy under secretary of the US Air Force for space programs will be the speaker at the DSS plenary session.

David Honey, director of the Research Directorate of the Director of Defense Research and Engineering at the US Department of Defense, will receive the DSS Lifetime Achievement Award.

Cost-effective opportunities

The DEPS conference program is a strong complement to the SPIE DSS program, said Andrew Brown, SPIE senior director for global business development.

The annual SPIE event was relocated to Baltimore a few years ago specifically in response to US government concerns regarding efficiency and to support the needs of the optics and photonics community in the Washington, DC, area.

SPIE is very sensitive to the need for fiscal responsibility, Brown said. Having the additional optics and photonics organizations at the Baltimore Convention Center at the same time as SPIE DSS “enhances an already cost-effective opportunity for government scientists, engineers, and project managers in the region to access mission-critical information and to meet efficiently with suppliers to develop solutions to their problems,” he said.

“Likewise we are creating a unique opportunity for industry to showcase their newest products and capabilities to a targeted audience. It’s a win-win situation that is valued by government and industry participants.”


“Given new budget realities, being in Baltimore helps leadership and attendees by greatly reducing travel costs,” Eismann said.

More information: spie.org/DSS.

Topics expected to receive wide attention at SPIE Photonics Europe, 14-17 April, include funding for optics and photonics research under the European Union's Horizon 2020 program and next year's celebration of the International Year of Light and Light-based Technologies.

Although details were not available before SPIE Professional's printing deadline, updates on both matters were being planned as part of 1500 presentations in Brussels during the week.

Eighteen conferences will cover such subjects as neuro photonics, silicon photonics, quantum optics, semiconductor lasers, micro- and nanotechnologies, and metamaterials.

SPIE Photonics Europe will also host the European Village and the sixth Photonics Innovation Village, a competition to encourage commercialization of optics and photonics research and technology into useful products, in the exhibition hall.

Other events include the SPIE Student Chapter Leadership Workshop, to be held 13 April, and daily “Hot Topics” sessions.

General chairs are SPIE Fellows Francis Berghmans of Vrije Universiteit Brussel (Belgium) and Jürgen Popp of the Institute of Photonic Technology Jena (Germany); Ronan Burgess of the European Commission Joint Research Centre (Belgium); and SPIE Senior Member Peter Hartmann of SCHOTT (Germany).

Featured speakers in Brussels

Featured speakers at the “Hot Topics” program who had been confirmed as of early December are:

- Raymond G. Beausoleil of HP (USA)
- SPIE member John Dudley of Université de Franche-Comté (France)
- SPIE member Frank Koppens of Institut de Ciències Fotòniques (Spain)
- SPIE member Michal Lipson of Cornell University (USA)
- Marc Sciamanna of Supélec (France)
- John Sipe of University of Toronto

More information: spie.org/pe.
Hundreds of optical innovations to be presented at SPIE Medical Imaging

Innovations in image processing, quantitative methods to integrate multiple sets of imaging data, computer-aided diagnosis, picture archiving, and related optical technologies will be presented at SPIE Medical Imaging, 15-20 February in San Diego, CA (USA).

The annual symposium will have nine conferences with more than 1000 presentations on the latest medical imaging research. Papers will be presented on wearable technologies, ultrasonic imaging, optical coherence tomography, image perception, image-guided procedures, metrology, and more.

In addition to the conferences, the event includes numerous workshops, technical events, and panel discussions, including demonstrations of computer-aided diagnosis (CAD) technologies and a discussion of CAD successes and failures.

Technology transfer events include a workshop on commercialization of medical research, and attendees will have an opportunity to meet one-on-one with staff from the US National Institutes of Health to learn more about preparing grant applications.

John Gore, director of the Institute for Imaging Science at Vanderbilt University (USA), will give the plenary talk on the emerging role of quantitative imaging biomarkers. Gore will discuss the importance of integrating multiple data sets from different modalities such as PET and MRI and using the imaging informatics to assess metabolic and physiological states, disease risk and progression, and even new drugs and medical treatments.

Nine experts in CAD, image perception, neurophotonics, digital pathology, acoustic microscopy, and related technologies will give keynote talks during the week.

Michael J. Hawrylycz, an investigator at the Allen Institute for Brain Science (USA), will discuss digital brain atlases in one keynote talk. The other speakers are Jeremy Wolfe, Richard Levenson, Charles A. Taylor, Simon Cherry, Nico Karssemeijer, Eliot L. Siegel, Robert L. Galloway, and Roman G. Maev.

Symposium chairs are SPIE Fellow Ehsan Samei of Duke University (USA) and David Manning, a professor at Lancaster University (UK).

More information: spie.org/MI.

Seeking alternative technologies at SPIE Advanced Lithography

Hybrid and other “alternative” technologies for faster, smaller, and cheaper chips required by the semiconductor industry will be highlighted at SPIE Advanced Lithography, 23-27 February in San Jose, CA (USA).

The annual symposium will include seven complementary conferences as well as panel discussions, seminars, and an exhibition devoted to applications, tools, patterning materials, and topics related to EUV lithography, metrology for microlithography, and alternative lithographic techniques.

The event provides a forum for industry and academic experts in all areas of lithographic patterning technology who are challenged with cost-effectively extending lithography to the next node while also striving to bring newer technologies to production readiness.

Conference sessions on EUV lithography will likely have the most presentations this year; however, the growing number of papers reporting advances in optical (non-EUV) and next-generation lithography (NGL), metrology, and inspection illustrate the interest in directed self-assembly (DSA), smart resists, and combinations of novel lithographic techniques in chip manufacturing of the future.

The all-conference plenary session will open with a talk from 2013 SPIE President William H. Arnold, chief scientist and vice president of ASML’s Technology Development Center. Other plenary speakers are:

- Joseph Sawicki, vice president and general manager of the Design-to-Silicon division at Mentor Graphics, will discuss advances in electronic design automation (EDA) and working with patterns throughout the design and manufacturing flow.
- Akihisa Sekiguchi, corporate vice president and deputy general manager at Tokyo Electron Ltd. (TEL), will give a talk on the future and alternative forms of scaling.

Special events include the announcement of the 2014 Frits Zernike Award for advances in optical microlithography, discussions on nanotechnology and managing EUV masks, and a panel discussion on non-EUV solutions.

Among the 13 courses offered onsite are new ones on computational lithography and management of metrology toolset.

SPIE Fellows Harry J. Levinson of GLOBALFOUNDRIES and Mircea V. Dusa of ASML US are symposium chair and co-chair, respectively.

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

<table>
<thead>
<tr>
<th>Event Name</th>
<th>Dates</th>
<th>Event Code</th>
<th>Event Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photons West</td>
<td>1-6 February 2014</td>
<td>spie.org/pw2014</td>
<td></td>
</tr>
<tr>
<td>Smart Structures/NDE</td>
<td>9-13 March 2014</td>
<td>spie.org/ss2014</td>
<td></td>
</tr>
<tr>
<td>IS&amp;T/SPIE Electronic Imaging</td>
<td>2-6 February 2014</td>
<td>spie.org/el2014</td>
<td></td>
</tr>
<tr>
<td>Photonics Europe</td>
<td>14-17 April 2014</td>
<td>spie.org/pe2014</td>
<td></td>
</tr>
<tr>
<td>Medical Imaging</td>
<td>15-20 February 2014</td>
<td>spie.org/ml2014</td>
<td></td>
</tr>
<tr>
<td>Advanced Lithography</td>
<td>23-27 February 2014</td>
<td>spie.org/al2014</td>
<td></td>
</tr>
<tr>
<td>Translational Biophotonics</td>
<td>19-20 May 2014</td>
<td>spie.org/tb2014</td>
<td></td>
</tr>
</tbody>
</table>

Abstract and application due dates

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

**2014**

<table>
<thead>
<tr>
<th>Due Date</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 January</td>
<td>Abstracts due for Optical Fibre Sensors (OFS 23)</td>
</tr>
<tr>
<td>27 January</td>
<td>Applications due for Photonics21 Student Innovation Award</td>
</tr>
<tr>
<td>31 January</td>
<td>Applications due for an SPIE Education Outreach grant</td>
</tr>
<tr>
<td>1 February</td>
<td>Submission deadline for Neurophotonics special section on the BRAIN initiative.</td>
</tr>
<tr>
<td>3 February</td>
<td>Abstracts due for SPIE Optics + Photonics</td>
</tr>
<tr>
<td>10-21 February</td>
<td>ICTP Winter College on Optics Applications due for SPIE education and travel scholarships</td>
</tr>
<tr>
<td>15 February</td>
<td>Photonics21 Annual Meeting</td>
</tr>
<tr>
<td>27-28 March</td>
<td>USA Science and Engineering Festival</td>
</tr>
<tr>
<td>26-27 April</td>
<td>USA Science and Engineering Festival</td>
</tr>
</tbody>
</table>

Find photos and daily summaries of many SPIE meetings online at spie.org/eventNews

Also follow SPIE on:

- LinkedIn
- Facebook
- Twitter
- YouTube

Advertise Here!

Build visibility in the optics and photonics community by advertising in SPIE Professional magazine, the easiest and most reliable way to reach the 18,000 members of SPIE.

Advertisers reach readers of both the print and online editions.

Contact Lara Miles at laram@spie.org for details.

International Year of Light

Read more about the International Year of Light at spie.org/iyl.

Supported by SPIE and 100 international partners and coordinated by the European Physical Society under the auspices of the UN, the International Year of Light and Light-based Technologies is a global initiative for 2015 to highlight the importance of light and light-based technologies.

FREE SPIE conference app

See complete programs of all presentations, exhibitors, and special events. Sort by relevance and create a schedule. Add notes, see the attendee list, be notified of upcoming events, and see Yelp reviews of nearby businesses.

Available at spie.org/mobile, Android Market, and AppStore.

Find photos and daily summaries of many SPIE meetings online at spie.org/eventNews

Also follow SPIE on:
With CODE V software, you can produce innovative optical designs that are cost effective to build. And we continue to invent advanced technologies to help engineers solve optical problems faster and easier than ever before. Here are just a few reasons to choose CODE V for your optical design project.

- **Expert tools for smart designs.** Optical engineering expertise embedded in CODE V’s Glass Expert and Asphere Expert tools accelerates the design process and ensures optimum results.

- **Optimization for superior results.** Early in the design process, Step Optimization quickly converges on a solution that yields superior optical quality – saving you substantial time and effort.

- **Tolerancing for cost-effective designs.** Using the fast wavefront differential tolerancing algorithm, CODE V’s Reduce Tolerance Sensitivity feature allows direct, efficient optimization of as-built RMS wavefront error performance. This approach reduces sensitivity to fabrication and assembly errors, which minimizes production costs.

Learn more about our innovative solutions at http://optics.synopsys.com/codev