LIA TODAY

VOLUME: 27 NO: 2 | MAR/APR 2019

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SHAPING THE FUTURE OF OPTICS & PHOTONICS: AN INTERVIEW WITH DR. ALEXIS VOGT

By Natalia Chekhovskaya Kearney

Endowed Chair and Associate Professor of Optics at Monroe Community College, Dr. Alexis Vogt talks about the growing demand for precision optics programs in community colleges, the need for female role models in STEM fields, and some of the challenges of being a woman working in optics.

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LASERS, LASERS EVERYWHERE, BUT FEWER IN COMPLIANCE

By Nathaniel J. Leon & Scott Wohlstein

The proliferation of inexpensive semi-conductor lasers used in laser pointers and embedded into commercially available products has resulted in an increasing subset of devices reaching the marketplace that are non-compliant with regulations and/or standards. Many such devices are inexpensive enough to be purchased on company purchasing cards, bypassing formal oversight by Laser Safety Officers (LSO's). Nathaniel Leon and Scott Wohlstein discuss case studies of how their step-by-step approach, SLaPP, can address this problem.

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By Nissim Asida

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By Chrysanthos Panayiotou

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LIA TODAY

THE OFFICIAL NEWSLETTER OF LIA

LIA TODAY is published bimonthly to educate and inform students and professionals of challenges and innovations in the field of photonic materials processing.

FEATURES

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LIA PRESIDENT'S MESSAGE

Spring is very much in the air; flowers bloom together and everything is recovering after the cold winter. Last year, we celebrated the 50th anniversary of LIA. This year, we start a new journey into the next 50 years. LIA has clarified its mission, vision and destination. As the saying goes: a journey of a thousand miles begins with the first step. LIA will focus on and pay attention to everything related to its mission, especially at ICALEO 2019 in October.

This issue of *LIA TODAY* covers pretty diverse topics about STEM education, optics for drones and the proliferation of non-compliant lasers. In the featured article, Natalia Kearney interviews Dr. Alexis Vogt about her work in bridging the gap between colleges and the opitcs industry, and how she inspires youth with STEM, particularly in optics. The second article is contributed by Dr. Nissim Asida, Director, R&D and Engineering at Ophir Optics, responding to the optical needs to the rapid development in unmanned aerial vehicle (UAV) system. When detectors become larger in size and smaller in pixel size, UAV optics with higher MTF values and lower F-numbers are the key to maximizing imaging performance. The third article relates to the safety and regulation issues resulting from the extensive use of inexpensive semi-conductor lasers used in laser pointers and embedded into commercially available products, which are non-compliant with regulations and standards.

Enjoy this spring season and this issue of *LIA TODAY*.

Minlin Zhong
President

EXECUTIVE DIRECTOR'S MESSAGE

I would like to thank all who participated in the International Laser Safety Conference (ILSC) 2019, including planners, chairs, presenters, sponsors, partners, vendors and attendees, for making this event a unique experience. We had the highest number of registrants and the largest revenue compared to any past ILSC. This was my first ILSC and I was impressed by the breadth of topics covered in plenary sessions, laser safety scientific sessions, the practical applications seminars, and poster presentations. I especially found the panel discussions, question and answer exchanges and the redesigned sponsor reception to be informative and interesting.

There were several announcements made during ILSC. During the Board of Laser Safety's (BLS) Board of Commissioner's meeting, Gus Anibarro, LIA director of education, was appointed and confirmed as the new BLS Executive Director. At the ASC Z136 annual meeting, Liliana Caldero, LIA manager of standards and publications, was announced as the new administrative secretary for the ASC Z136.

On behalf of LIA I congratulate the following award recipients:

Dr. Robert Thomas (*Wilkening Award*); Jamie King (*Rockwell Award*); Lawrence Livermore National Laboratory (*BLS Illumination Award*); Agiliti Inc. (*BLS Illumination Award*), Mount Sinai Medical Center (*David H. Sliney Award & Achievement in Laser Safety Education (ALSE) Excellence)*; and by industry: Tesla /Automotive, Boeing/Aerospace, the United States Air Force /Defense, Mount Sinai Medical Center/Healthcare Services, ConMed Corporation/Medical Devices, the Food and Drug Administration/Life Sciences, Sandia National Laboratories/ Research and Development, Loughborough University/Academic and Public Sector, Qualcomm/Microelectronics, and FARO Technologies/Specialized Manufacturing and Services *(Achievement in Laser Safety Education (ALSE))*.

Continuous improvement of this conference requires your candid recommendations and ideas. Please complete the conference survey at your earliest convenience.

Nat Quick
Executive Director

Shaping the Future of Optics & Photonics

Endowed Chair and Associate Professor of Optics at Monroe Community College, Dr. Alexis Vogt talks about the demand for precision optics programs in community colleges and the need for female role models in STEM to inspire young girls to join the ever-growing fields of optics & photonics.

An Interview with Dr. Alexis Vogt

Natalia: This morning, I have the great privilege of talking to Doctor Alexis Vogt, an Endowed Chair and Professor of Optics at Monroe Community College in Rochester, New York. Dr. Vogt has had a very impressive and successful career in photonics, both in industry and academia. She volunteers a lot of her time during her already busy days to serve the local, national and international communities and inspire youth in STEM and optics. In addition to all of these, she is a mom of three young children. Doctor Vogt, thank you so much for your time this morning.

Natalia: Dr. Vogt, thank you so much for your time this morning.

Dr. Vogt: Likewise. I'm pleased to have the opportunity to talk with you on this really important topic. Thank you, Natalia.

Natalia: Thank you. Can you please talk a little bit about yourself, your background, where do you currently work, and your current position?

Dr. Vogt: My number one job is to be a mother and a wife. I have three children: a 6-year-old, a 4-year-old, and a one-and-a-half-year-old. In addition to that, I am the Endowed Chair and Associate Professor of Optics at Monroe Community College. My background is in optics; I have a PhD in optics from the University of Rochester's Institute Of Optics. Upon completing my PhD, I worked in the optics industry here in Rochester. At Bausch+Lomb I designed contact lenses and then I went to work at Melles Griot (IDEX).

I really enjoyed my time in industry, but what I recognized, was that in the Rochester community we have a severe shortage of optics technicians. The technicians were pivotal to the role of the work that we were doing at Melles Griot, and when some of the key technicians were out of town, we didn't ship product out the door. What I learned was that this was not a problem only happening at our facility, this is a problem happening at other companies around the Rochester area. Here, in Rochester, we have over 120 optics companies and nearly every single one of them would like to hire an optics technician today.

What I learned then was that Monroe Community College (MCC) is the only community college in the entire country that has a precision optics program so the onus is on MCC to produce more highly skilled optics technicians to meet the demand. I left industry three years ago to join Monroe Community College as the Endowed Chair and Associate Professor of Optics to revitalize the optics program, update the curriculum, teach the skills that are needed by our industry partners, and ultimately increase the number of graduates.

After being in the job for one year, I realized that this shortage of optics technician is not isolated to

“My mission now is to work to find a way we can create more highly skilled optics technicians to fill the need, not only of the optics companies here in Rochester, but optics companies around the world. One of the ways in which we need to do that is to encourage more women and more girls to pursue STEM fields.”

Rochester. In fact, it’s a nationwide problem. And then, upon completing my second year at MCC, I recognized that this is not even a nationwide problem, this is a worldwide problem. There are companies in Germany who are reaching out to me to ask how they can hire technicians who graduate from our program. My mission now is to work to find a way we can create more highly skilled optics technicians to fill the need, not only of the optics companies here in Rochester, but optics companies around the world. One of the ways in which we need to do that is to encourage more women and more girls to pursue STEM fields.

I’m very passionate about encouraging young children, young girls in particular, to grow and become interested in STEM fields, and most specifically optics.

Natalia: You mentioned that you joined Monroe Community College about three years ago. What do you find that you enjoy the most in your career in academia?

Dr. Vogt: By far, my favorite part is to see the students succeed. The students’ success is my motivation, more than anything else. I am passionate about educating the wonderful students in our program. Just this morning, when I concluded teaching my class, I was talking to the students about their upcoming graduation and one student mentioned that he will be the very first person in his entire family to graduate from college. He spoke of how excited his mom is for him to be in this position; none of his siblings nor his parents had ever finished college and here he was, the first to do so. What an incredible accomplishment and success story! That’s what I love most about my job.

I have another student who joined the program the same year that I did. He was in one of my very first classes, and he told me that he was trying college for his third and final time. If it didn’t work, he was going to give up. My initial reaction was to question why he was telling me, on my very first day of class, that he had failed twice before? It turned out my initial concerns were ill-conceived and he became one of the top students in the class. Through the MCC optics program he found his niche, excelled in his classes, graduated from our program, and found an R&D position at a company here in Rochester. When he was hired he told me his mother was so excited and proud she started crying. His success has continued - just recently he was accepted into the Rochester Institute of Technology to complete his bachelor’s degree. These student successes are my primary motivation.

Second to student success, I would say I also really enjoy interacting with our industry partners. We are fortunate here at Monroe Community College to have incredibly supportive industry partners including Sydor Optics, Corning, Optimax, and many others, who are very supportive of our program both financially and through enabling and encouraging their employees to take classes while they’re working full time. I am particularly motivated to give back to those companies in the form of highly skilled precision optics technicians.

I am fortunate to be in this role and am excited when I can see both the connection between a successful student who finishes our program and contributes to our optics industry, and filling the void of optics technicians desperately needed in the world as well.

Natalia: Very often, we witness no bridge between the photonics industry and colleges.

Dr. Vogt: Yes, in fact, earlier today I was emailing a colleague at another community college and he was asking how we are successful at MCC. My response to him was that in large part, we’re very fortunate to have the support of our administrative team and our industry partners.

Dr. Anne Kress is the President of Monroe Community College, and she arrived on campus to a nearly defunct optics program. In fact, no one was graduating from the program. The equipment we use is expensive and takes up a lot of space, and she was directed by the previous administration to close the optics program because financially it didn’t make any sense. Thankfully, she had a great deal of foresight to recognize that would have been

a terrible mistake.

She instead kept our optics program open and we're now in this turn-around period. There is no doubt that the support she provided has been very influential on our program and so too has the support of our industry partners.

Our industry partners, like Jim Sydor from Sydor Optics, have been huge advocates for our program. Jim himself is a graduate of our program and has been a proponent of strengthening and growing our optics program. He has gone so far as to donate $250,000 to our program to purchase new equipment, to bring us back to being state of the art. Our program wouldn't exist without our industry partnerships. We're very, very blessed to have such strong industry partners who believe in what we're doing, who are there to offer me support, who open their doors for our classes to tour, and provide our students summer internships and full-time employment. We are in a very fortunate position.

Natalia: It is worth mentioning that if a photonics company struggles to fill-in technical positions, it would be wise to identify a community college nearby and assess the state of their technical programs relevant to the field. With industry support and curriculum guidance, colleges can graduate techs with tailored theory background and skills.

Dr. Vogt: Yes, that's really what we need. When I started in this position three years ago, I thought it was so wonderful to be able to tell that MCC is the only community college in the entire country with a precision optics program. And where we are now, what I've since learned in the last three years, is that that's in fact terribly frightening. And that's no longer a statistic that I'm proud of.

We are at a point right now where we need other community colleges to start precision optics programs. And this is a very influential and important time for us in the community college landscape. I'm fortunate to now be working with wonderful leaders from around the country in various different community colleges, including LASER-TEC, MPEC and others where we are working to unify our resources and hoping to work together in a cohesive way such that we all can create more technicians, so that we have more laser technicians, more precision optics technicians, more fiber optics technicians. If we can work together, we will be able to strengthen our program and improve upon the number of technicians we are graduating in the optics and photonics space.

I'm pleased to say that we now do have a couple of other community colleges who are starting precision optics programs. And we're certainly happy to assist any of them, so that we can have more graduates filling the sizable gap within our workforce.

Natalia: Yes, and those are really good points. Going back to your background, reflecting on your childhood, your family, people around you, your school, the University, can you think of an event or maybe a series of events that settled you in pursuing optics?

Dr. Vogt: Well, it's a great question. It's been fun to reflect back on that and try to think about the specific incidences or events that I recall as being pivotal. I attribute everything to God and to my parents. God has enabled me, has given me all these wonderful opportunities. And to my parents who raised me along with three other siblings to realize that anything is possible. I'm the oldest of four children. My brother and I both ended up in the optics field, one of our sisters has a degree in English and the other sister is a fashion designer. We have this split between the four of us.

Neither of our parents is an engineer or scientist or involved in STEM in any way. My father is a Lutheran minister and my mother worked as the Field Office Director for HUD for New York State. So, neither is involved with STEM fields, but yet, they made opportunities available to us and always made it quite clear that we could do anything we were interested in pursuing.

I went to the University of Rochester, and I was really attracted to the school in part because the University has so many strong programs and I did not know what I wanted to study. I'm also a violinist and was certainly attracted to the University of Rochester's Eastman School of Music and the opportunity to take lessons there for free.

In my freshman year, second semester, I had some friends who were a year ahead of me tell me, "You should take this Introduction to Optics course because even if you don't like the material, the professor is incredible." I thought that sounded pretty good so I took the Intro to Optics course and found both the material fascinating and the professor was every bit of incredible. His name is Turan Erdogan, and he was the one who made optics exciting and was the first person who opened this field to me. Frankly, I went into the University of Rochester not

knowing you could even study optics as a career choice. I learned about the optics career opportunities, and I learned that the University of Rochester is one of the few places you can end up with a bachelor's degree in optics. So, I took more and more optics classes, and I really enjoyed them. I was fascinated by how optics explains so much of the world around us.

As we are often blessed in our lives, wonderful people sometimes circle back. Turan Erdogan ended up leaving the University of Rochester to start his own optics company and when I was working at my previous company he ended up being hired as my boss. I was very fortunate to work with him as my manager, as my supervisor. And he was just as incredible as a supervisor as he was as a professor. So, without a doubt he is single-handedly the one person who really opened up the career to me as an opportunity. And that was because I took his Introduction to Optics class.

It's funny though to think back even further into my childhood - I have really fond memories of being in sixth grade and working on a project with my dad for science class. We built a five-foot periscope. It was white with red tape and had 6 inch diameter mirrors. I can picture it vividly. I was fascinated by the way in which it worked. My dad and I worked on this project together and that was my first ever optics demo in my life. And I remember being mesmerized by it, but I didn't realize how significant it would be on the trajectory of my career

That periscope sat in our basement for years and years and years because I didn't want to get rid of it. It's really just fascinating and serendipitous how all of these things work together. I am very blessed to be where I am right now.

Natalia: Among all the people who influenced you

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and your decisions, were there any women? Were you looking for a role model around you? Did you feel the need for a role model at all to be in the photonics field?

Dr. Vogt: Certainly, without a doubt, the one female role model I had was my mom. She modeled not by telling me what to do, but by being an incredible woman. I observed and have tried to emulate her. She held a high position in Housing and Urban Development and she managed many people. A lot of the interpersonal skills, the way to carry yourself, the way to interact with people, proper grammar, were things that I picked up from my mother. Certainly raising children I picked up from my mother as well.

When I think back to female role models within my optics career, I was at the University of Rochester for eleven and a half years straight between my undergrad and my PhD program, and I only had one female optics professor - one time, for one semester, the whole time I was there.

Susan Houde-Walter was my only female optics professor. She taught our 8 am Optoelectronics course my senior year and she was a role model in the way in which she too carried herself. She was extremely punctual, very formal and she ran a tight ship. She was a terrific professor and I respected her immensely.

Because there have been so few women that I have interacted with in the optics field, I haven't had the opportunity to have a female mentor. I feel fortunate that I've worked with many wonderful colleagues, but simply because of the demographic they've nearly all been men.

Natalia: There is a big misconception that STEM fields, including optics and photonics, are extremely technical and disconnected with the real world. How do you think photonics and optics make this world a better place? What tools and solutions do they offer to make us have better lives?

Dr. Vogt: This is the fundamental purpose of my Introduction to Optics class that I teach at Monroe Community College, which I also offer as a dual enrollment partnership with high schools. I share my curriculum with high school teachers who then teach my course to their students. The students who successfully complete the course receive college credit for MCC and hopefully come to MCC to study optics.

The purpose of the course is that optics is all around us. To give a few examples, I explain how rainbows are formed, I spend an entire lecture where I talk about how optics is used in a grocery store. I talk in detail about how smart phones work, and the advancements that have come about because of optics and photonics. I try to tie everything into what we do on a daily basis. Whether it's

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watching Netflix and streaming videos, none of it would be possible without optics and photonics.

I think it's really important to incorporate the tangible pieces of optics and photonics for people to recognize "Wow, this is a really fascinating field." The recent images of Pluto, or of Earth taken from satellites, or Google Maps images were gathered with optics that were created and manufactured here in Rochester. 3D movie projectors have optics that are made by companies located in Rochester. The night vision goggles used on the assault on Bin Laden were designed and manufactured here in Rochester. There are photonics companies working on ways in which we will only have to charge our smart phones once a month, rather than every single night. These types of advancements are the work of optics and photonics.

And the list of things and advancement that occur because of our field goes on and on and on - that is what is so exciting about the field. Our field is changing the way which we live our lives and the things that we can do. If we show middle schoolers and high schoolers, particularly girls, how our lives revolve around optics and photonics we will see more people pursue STEM fields.

Natalia: As I go over your impressive resume, I see that you worked on the designs of contact lenses. Your effort in optics has improved lives of many people; thanks to your work, there are less people experiencing discomfort because of their visual impairment and more people who enjoy their fulfilled lives. There are other ways to help people, besides being in the medical field.

Dr. Vogt: Optics enhances our lives in ways in which we are not even aware. Lasers, lenses, fibers, optics, LEDs – the list goes on and on. We have optics to thank for back up cameras in our cars, smart phones, solar panels, streaming videos, imaging during disaster relief and search and rescue operations, barcode scanning, and autonomous vehicles. And the list continues.

That to me is what's really motivating about this field we are both a part of – we are part of future innovations and advancements. I hope that we can encourage others to follow our passions, and follow our pursuits, and can join us in the field too.

Natalia: What do you think deters girls from entering this field? What do you think is the factor, or multiple factors, that prevent girls from thinking, "it's interesting and I can do it"? Some research suggest that it is embedded in human psychology: women are usually more careful risk-takers, have higher sense of responsibility for families, and possibly, these are factors preventing them from necessary steps to enter and advance their careers. What are your thoughts on that?

Dr. Vogt: My husband and I climbed Mount Rainier with my dad a few years ago, before we had children. The experience was thrilling, challenging, and terrifying. Although there were moments when we weren't sure we were going to survive, we made it to the summit. My husband is ready to go again, but I have no interest at all. I will not be climbing Mount Rainier again. We have three children we have to be responsible for now.

Is it sensibility or is it risk-taking that differs between the two? I don't know which, but I do think that perhaps women as more careful risk-takers could be a reason we don't see as many girls pursuing STEM fields. I think another reason is because we don't have enough female

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role models. If you look at a STEM field, and you look to see who is teaching classes at our community colleges and universities, they are largely men. We as human beings emulate people we see. If girls don't see women teaching their STEM courses or holding leadership positions in optics companies they are less likely to enter STEM fields.

I also think that there is an element that comes into play, perhaps somewhere in middle school and high school, where girls start to think, "Math is boring…I don't like math…I don't want to do math…I'm not good at science." When they're young that perception doesn't even exist. My daughter is in first grade right now and she loves math. Even before, when she was she was in kindergarten, she would talk about her bus number, which was 34. She would see 3 and a 4 everywhere we would go and she would point out the numbers. The question is: why might she, at some point down the road, change her perceptions of math?

Math in many ways is like a language. We all learn to speak a native language. We all learn to use math. But at some point people decide, "I don't like math." What do you mean you don't like math? We use this every single day in all that we do. How do you dislike it? It's like disliking the English language. But I think that there is a pivotal point that occurs. Maybe it's not as cool for a girl to like math, or to like science. And so I think there are some stereotypes that we need to overcome.I also think that we have a responsibility to get into, not just high school but middle schools, elementary schools and show all students, not just girls, but all students, what you can do if you like math, if you like science, if you go into a STEM field.

The discussion we just had about the ways in which optics is used, we need to get that story out to middle schoolers, to elementary schoolers. I go into my children's day care program, because we can teach optics to 4-year-old's, and I did that just last Friday, in fact. I was in my son's class, and it's really fascinating, because he's seen me do my optics demonstrations a number of times through, and when I showed up in his class, he took the lead. He was able to teach his other friends, his 4-year-old friends, how liquid crystal patches work, how polarizers work. He didn't know all of the terminology, but I was amazed that he clearly had been paying attention for all these other times that I've talked about optics. "Look mama, its optics," is their favorite phrase that they will shout out.

What this shows is we can get kids excited about optics and STEM fields at a young age. We just need to do more of it. And I think by encouraging students to pursue STEM fields at earlier ages, we will be able to see more women pursuing STEM. A lack of role models certainly contributes and a lack of awareness - students, women, girls, not even recognizing that this career exists or what you would do with it. If we show the ways in which we use math and science in our careers we will attract more girls to pursue STEM fields.

Natalia: Data shows that there is a huge attrition rate of young women who enter optics and photonics field. Why do you think this attrition is happening and what can industry do to help reduce that attrition?

Dr. Vogt: Well I certainly think this too has a number of facets, and a number of reasons why. Women see some of their male colleagues promoted more quickly. That could serve as a reason to change careers or change to a different company.

There is no doubt that being a mother and working fulltime is very challenging. Even if you have an equal partner helping to raise children, your daycare or your doctor will call the mother before they call the father. That's just how these things work. And you're called and you're told that your child is sick and you need to go pick them up.

There are many demands on women in the field, and many demands as a mother and as a wife. Juggling all of that together, sometimes women say, "Well this is going to be a lot easier if I just don't work anymore." And if you factor in the astronomical cost of daycare for some women, it is cost prohibitive to work and pay a daycare bill that is higher than an incoming salary. We lose women for that reason as well.

Our first step is to talk about this more, to have this discussion. This raises awareness, this spread the word. I talk openly about challenges I've encountered while breastfeeding and pumping I've breastfed all three of my children, and that's not an easy thing to do in a workspace. At a former employer I told the female head

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of HR that I was planning to pump upon returning from maternity leave and she said, "Well the last time we had this problem we just set up a chair in the handicap stall of the bathroom."

I thought, oh my goodness, there are so many problems with this statement. First of all, this was coming from a female HR professional with children of her own; secondly, my desire to pump was just identified as a problem; and third, the law states that I was entitled to a space outside of a bathroom stall. I had a supportive supervisor who was able to make sure I was given an adequate space to pump, but I am still in disbelief of the reaction I received from HR. And I know that I'm not the only female who has encountered a similar problem.

And not to mention the extreme difficulties in finding a company's policy for maternity leave. When you find out you're pregnant it's long before you want to tell your employer, but you want to research your maternity leave options to plan ahead. I have had a difficult time locating parental leave policies at employers. This shouldn't be the case. Maternity leave policy and benefits should be as easy to find as is information about your health insurance policy.

We need to talk more about the challenges working mothers face. I found the best use of my time, was to pump while driving my car. I wish I had figured that out for my first child, not my third. But to be able to talk about that, and to share experiences with one another, that's how we start to overcome this. We need the network of openness, where people are openly talking about, not only how they deal with being a mother, but even the challenges that are associated with what so many of us went through, of becoming a mother, and infertility and so forth, talking about those problems more openly.

And then, once you do have the children, how do you get through maternity leave, how do you manage working with daycare and pick up times, and being called in the middle of the day, and doctors' appointments. By talking more widely we will have a stronger network, a stronger community.

But there is certainly an opportunity for employers to have a better understanding of what it means to be a female, a working mother, and accommodations that are required. And certainly that includes things like, an appropriate place to pump, and then to store your milk. But then also to have an understanding and supportive nature of recognizing that children get sick, daycare will call in the middle of the day, and it may even be the middle of the day of a really important meeting. But this happens and every single one of us was once a child and was in this position so there's no reason that we should act like "this is such a surprise, I can't believe this happened. How will we deal with this?"

But I think that openness of employers [is important], and I do want to say that there are some wonderful employers out there who are very accommodating to their female employees. So this isn't to say that no one is doing this already, but I do certainly think that there is room there's room for improvement.

Natalia: Looking into the future, what do you think will be the biggest thing in photonics?

Dr. Vogt: We are going to see our lives impacted by optics and photonics. We will continue to see great explosion in the consumer field, the ways in which we live our lives on a daily basis. Foldable phones, autonomous vehicle, flights available to space for consumers, and the list of advancements resulting from optics and photonics continues. We will see advancements continue in medical applications with robotic surgeries, robots with optical sensors, and robots in different aspects of our lives.

There are so many different ways that we will see optics and photonics impact the world, and that's why it's such an exciting time to be part of this career.

These advancements are empowering, and exciting, and how we can captivate audiences, and encourage more children, and hopefully more girls, to pursue the optics field.

Natalia: What would you like to tell girls and young women?

Optics is a career path in which you can see the world. The opportunities are endless with this field, which is why I'm passionate about encouraging others to pursue this field as well.

Natalia Chekhovskaya Kearney is an Associate Director of LASER-TEC, A National Science Foundation Center of Excellence in Laser and Fiber Optics Education. She holds a M.S. Degree in Physics and has been in actively involved in national technical workforce initiatives for the last 7 years.

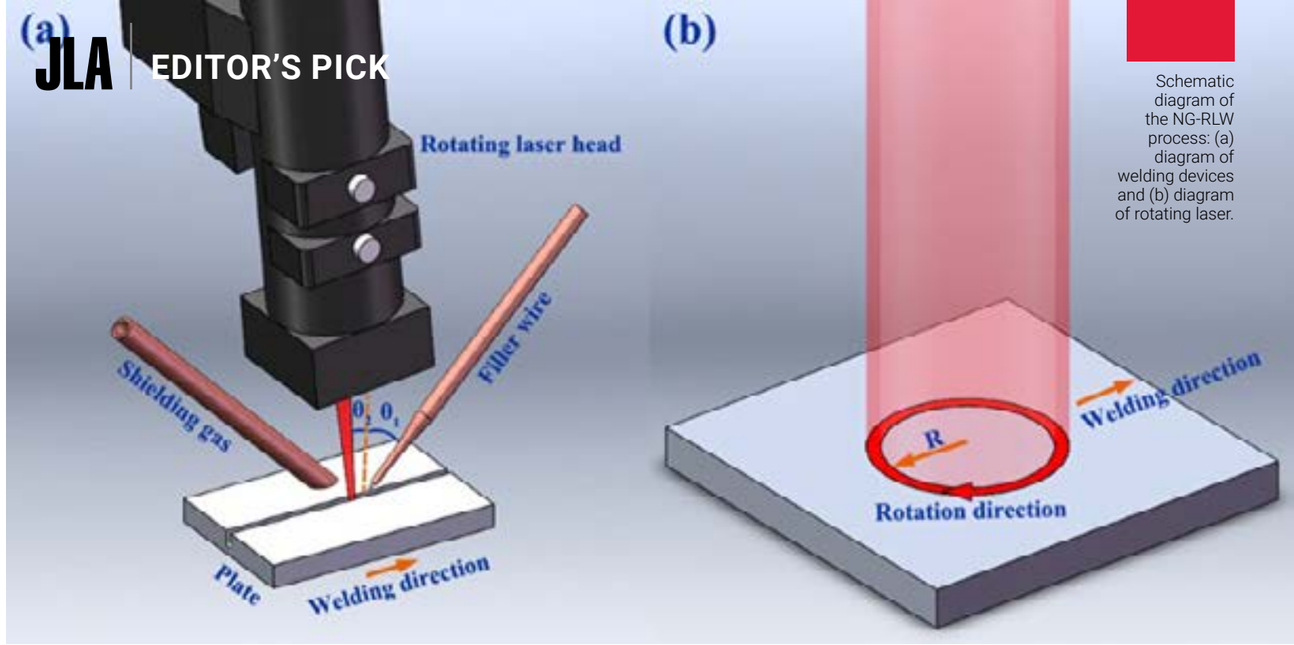
Dr. Vogt: I would like to tell them optics and photonics is the career of the future. This is an incredibly exciting field to be a part of. We are shaping the future. Even if you aren't the person who designs or manufactures optics, every single optics company has a sales person, a marketing person, a finance person, an advertiser. You could come to MCC, for example, learn optics for 2 years, go work for an optics company, and then pursue a business degree or eventually an MBA. Knowing the optics portion along with the business portion makes you an incredibly valuable asset to your optics company.

I see optics as a career that opens doors, that creates opportunities. Because you can learn optics first and then move into sales or marketing, for example. My brother is the head of sales and marketing for Optimax here, in Rochester. And at the moment he is in Zurich, in Switzerland. His career has enabled him to travel all over the world, and to see some extraordinary places.

Natalia: Photonics is a multifaceted field and it all depends on what one would like to pursue. Students can choose among various industries based on their interest. They can go into R&D, advanced manufacturing, analytical equipment, security and defense. They can work in the medical field, in the telecommunications field. Optics does provide a stepping stone to multiple opportunities; this is to echo to what you've been saying.

Dr. Vogt: Thank you for inviting me to have this discussion. The effort to encourage more girls to enter optics and photonics is work we all must take on. I appreciate you highlighting this issue; what you are doing is so valuable.

Natalia: Alexis, I cannot thank you enough for your time and your insights, your very wise words and wisdom.



Schematic diagram of the NG-RLW process: (a) diagram of welding devices and (b) diagram of rotating laser.

JLA | EDITOR'S PICK

JLA Journal of Laser Applications

MICROSTRUCTURE AND STRESS DISTRIBUTION of narrow-gap rotating laser welding thick Al-Mg alloy joint

By: Xiaoyi Yang, Hui Chena), Chengzhu Zhang, Zongtao Zhu, Chuang Caia), and Shuang Huang

Abstract: The microstructure and residual stress distribution of the 15 mm-thick 5A06 aluminum joint welded by narrow-gap rotating laser welding were investigated. The results show that the rotating laser can obviously decrease the porosity of the 5A06 aluminum joint. The weld metal (WM) mainly consists of the solidification structure, while the base metal (BM) and the heat affected zone (HAZ) present a rolling banded structure. The second phase in WM is dispersively distributed Mg5Al8, but BM and HAZ also contain (FeMn)Al6 and Mg2Si. Although the lowest ultimate shear strength τu was found in WM, its shear plasticity α is better than that of BM and HAZ. The maximum temperature of HAZ is higher than 280 °C, which exceeds the recrystallization temperature of 5A06 aluminum. Furthermore, the distribution of residual stress along the thickness direction shows a bimodal appearance.

Journal of Laser Applications 31, 022002 (2019)
https://doi.org/10.2351/1.5044704

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WHEN MINIMAL IS CRITICAL:

ENGINEERING OPTICS FOR UAV PAYLOADS

By Dr. Nissim Asida, Director, R&D and Engineering, Ophir Optics

Recent unmanned aerial vehicle (UAV) system developments have drawn attention to the optical needs of the UAV industry. As detectors become larger in size and smaller in pixel size, UAV optics with higher MTF values and lower F-numbers (F#) are the key to maximizing imaging performance.

The unmanned aerial vehicle (UAV) industry is growing rapidly, with Teal Group analysts estimating that worldwide UAV production will total $135 billion in the next ten years[1]. When equipped with high performance electro-optical/infrared (EO/IR) camera payloads, UAVs, also known as drones, lend themselves to a wide range of imaging applications.

The drone market consists of defense, government, and commercial applications. In the area of defense and government, drones are used for military and police surveillance, border control, security, and search and rescue operations. Between 2009 and early 2017, at least 347 law enforcement and emergency responder agencies in the U.S. acquired drones[2].

In the commercial drone market, demands have been growing. Commercial drones with thermal imaging capabilities are playing a prominent role in inspecting electrical power lines, oil pipelines, and other infrastructures. Thermal imaging drones are also used to assist in firefighting operations, locating and assessing fires, even when visibility is poor.

As UAV technology is implemented for increasingly varied and sophisticated tasks, there has been a call to maximize imaging performance. In particular, detectors are increasing in both resolution (number of pixels) and format (size), while decreasing in pixel size. Also, smaller drones are being manufactured for commercial use. These trends present specific optical needs.

While advances in detector resolution should improve imaging performance, this is impossible without an accompanying improvement in lens quality. In optics-limited systems, lens quality is essential - an inferior lens will produce an inferior image, even with the best detector.

In order to match these high performance detectors, lenses must be of the highest quality, meeting tighter tolerances for minimal aberrations. For example, the f-number (f#) of the lens must be decreased for smaller pixel size. This value represents the aperture size of the lens, with a smaller f# referring to a larger aperture, which delivers more light to the detector. Lenses must also have a long focal length, for use when UAVs capture images from large distances. Optics must have a high MTF (modular transfer function). This measure is frequently used to assess optical performance, as it incorporates both contrast and resolution, two characteristics necessary for a superior optical system.

The UAV industry presents its own unique set of limitations. When it comes to developing optical components and optical systems for UAV payloads, three factors must be measured. These factors can be summarized by the acronym SWaP – size, weight, and power consumption. UAV payloads, especially for smaller commercial UAVs, impose strict size and weight restrictions. Power consumption must be reduced to minimize fuel usage, thus maximizing flight time. As UAV detectors grow in size, it's more difficult to meet SWaP goals.The challenge falls on lens manufacturers to design and produce compact, lightweight lenses – minimal is critical. Concurrently, image performance must not be compromised. Various technologies are being used to meet these optical needs. These technological solutions include innovative optical and mechanical designs, exotic materials, free-form optics, and unique lens coatings.

Diamond turning technology can be used to produce aspheric and diffractive surfaces with exceptional levels of accuracy and quality. Aspheric lens surfaces are desirable, particularly when it comes to infrared optics, showing significant increases in optical performance over their spherical counterparts. Aspheric-Diffractive lens surfaces allow for the integration of multiple functions, such as chromatic and spherical aberration corrections. Lenses produced by diamond turning can therefore combine multiple elements, reducing overall size and weight.

Continuous zoom lenses, with maintained focus, are another way to reduce lens size and weight, while keeping performance high. These lenses are smaller and lighter than using multiple single field-of-view lenses. In addition, a continuous zoom lens enables better mission flexibility by allowing changes in magnification during a UAV operation.

The use of durable, anti-reflective lens coatings also improves optical performance, without any impact on the size or weight of the lens. Lens coatings minimize transmission losses by reducing reflection. Advanced coating techniques can be used to produce tailor-made coatings. These coatings can be designed to meet the needs of the UAV industry, where drones may be deployed in a variety of environments, each presenting its own optical challenges.

Ophir Optics develops high performance infrared lenses for various wavelengths, especially designed to meet the requirements of the UAV industry. Our lenses were created in collaboration with defense and commercial customers, and take the SWaP constraints of the UAV payload platform into consideration. We uses lens types such as continuous zoom lenses, athermal lenses, as well as technologies such as diamond turning, free-form optics, and advanced lens coatings, to reach the highest levels of IR thermal imaging performance quality. Ophir's most recent lens, the LightIR, is a high-performance IR thermal imaging zoom lens designed specifically for use in UAV payloads. The LightIR is the smallest, lightest, and best lens of its type, available on the market today.

Optical solutions are the key to UAV performance, maximizing imaging quality, without a heavy toll on the UAV payload. As UAV technology continues to develop, and the demand for UAVs increases, optics will continue to play a vital role in the industry.

[1]Teal Group (2017)
[2] Gettinger, D. (2017). Public Safety Drones. Retrieved from Center for the Study of the Drone.

The drone industry is growing, necessitating high performance optics that meet SWaP restraints.

The LightIR 20-275 mm f/5.5, for MWIR cooled cameras. Weight: 264g, Dimensions: Ø58mm X 67.1mm.

The SupIR 15-60mm f/1.4, for LWIR uncooled cameras. Weight: 500g, Dimensions: Ø62mm X 80mm

Dr. Nissim Asida is the R&D and Engineering Director at Ophir Optics. Nissim has over 25 years of experience in optics and lasers. He has been Ophir Optics' R&D and engineering director for the past 21 years, prior to which he worked at Elbit's electro-optics division, as project manager. Nissim holds a PhD in physics from Bar Ilan University, in the fields of non-linear optics and lasers.

LASERS, LASERS EVERYWHERE, BUT FEWER IN COMPLIANCE

By Nathaniel J. "Niel" Leon & Scott Wohlstein

The proliferation of inexpensive semi-conductor lasers used in laser pointers and embedded into commercially available products has resulted in an increasing subset of devices reaching the marketplace that are non-compliant with regulations (e.g.; 21CFR1040.10/.11) and/or standards (e.g.; the Z136 series and IEC/EN60825). Many such devices are inexpensive enough to be purchased on company purchasing cards, bypassing formal oversight by Laser Safety Officers (LSO's).

Users tend to work with them immediately, especially when these devices are believed to be Class II/2, Class IIIa/3R or lower. As presented in our paper "*Zeroth Responders - LSO's Reporting Non-Compliant Lasers –Why, How, and to Whom - A step by step guide*"(ILSC 2017), we have developed a process which will allow LSOs to readily document and determine the appropriate disposition for lasers found in their inventory. The process was developed with guidance from relevant federal, state, and local agencies to take users step-by-step through the complexities of determining the regulatory compliance and user safety status of laser-based products. It is called: the Suspicious Laser Product Protocol, or "SLaPP".

The paper and associated check list provides LSOs with a set of tools based on real experiences. The experiences include:

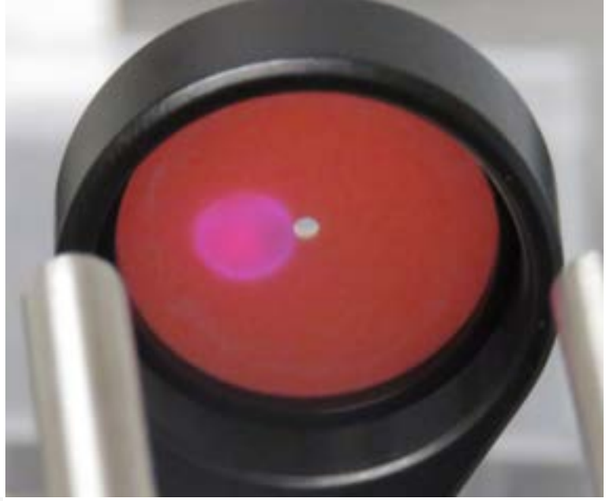
- As part of their technology acquisition process, a new company purchased the rights to produce and distribute a commercial telecom system. The original claim was that the products were Class 1, but they contained Class 3B and 4 lasers, which were found to have misleading labeling, documentation, and missing engineering controls.

  The process identified the issues that needed to be addressed and allowed the new company to reduce the acquisition cost by the expense required to upgrade the systems, so they were compliant with all necessary standards.

- A multiple-unit measuring system installed into a linear production line was missing anything identifying compliance to any accepted standard. The systems contained 50 mW 650 nm Class IIIb/3B lasers, though the system claimed to only include Class IIIa/3R lasers, based on minimum emissions, not maximum as required by regulations.

  These systems were sourced through a European company, which refused to upgrade the documentation when presented with the issue. The systems' purchaser subsequently returned them to the manufacturer and replaced them with domestically sourced units, which successfully met the required standards.

- Two commercially available green laser pointers purchased from an online-only vendor were improperly labeled as Class 2. They were originally brought to the attention of the LSO by a user who noticed that the emissions of the two lasers pointers were significantly different.



This IR Spot Should NOT Be Present

A Simple Stand Made Better Experimental Set-up

The LSO measured emissions and determined that both were Class 3B, emitting more than ten and even more than twenty times the allowable visible light respectively. Additionally, there was significant IR radiation emitted due to faulty and/or missing IR filters. These were directly turned over to the Center for Devices and Radiological Health (CDRH) as being non-compliant and inherently dangerous. **Reference**

- An optical tweezer experiment purchased as a laser lab kit was installed in an undergraduate teaching lab. As a kit, it was not required to be fully Federal Laser Product Performance Standard (FLPPS) compliant. The document as received from the vendor indicated the same.

  To allow the kit to be used in an educational setting according to Z136.5-2009, an enclosure was developed and installed onto the five systems. The enclosure was labeled to indicate that the system was considered to be Class 1 for use at the institution, and that the system was not to be transferred outside of the university.

  These enclosures eliminated the need to have students wear laser protective eyewear (LPE) and implement entry controls, which would have cost the university more than $10,000. **Reference**

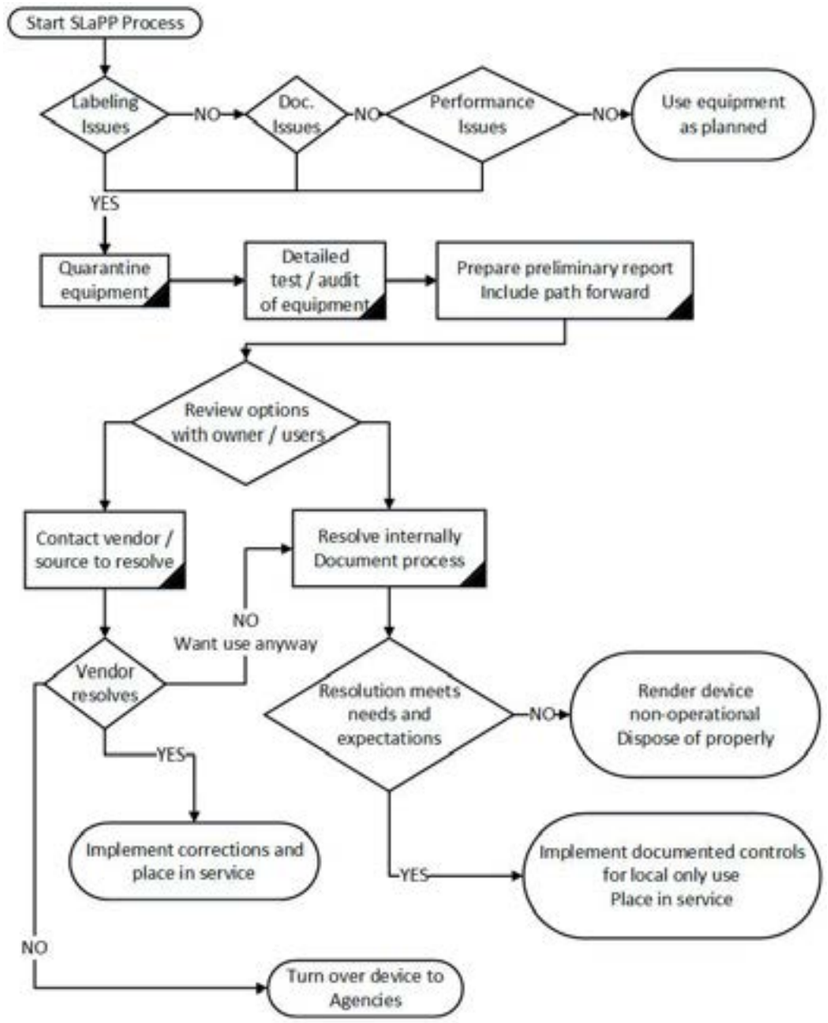
- Using personal funds, a graduate student purchased two 1 W lasers (808 nm and 980 nm) to conduct final experiments required to complete a PhD thesis. The student had no prior documented training to use lasers.

  After reviewing the basic experimental operational requirements and working hypothesis, the LSO determined that the experimental set-up could be readily modified to include a 3-D printed holding fixture that redirected the laser energy into the table. The fixture also included the means to hold the slide used to contain the test samples in the same position every time thus improving the repeatability of the experiment.

  These engineering controls, along with completion of the university's laser safety training course, and having the student develop detailed standard operating procedures, allowed the experiment to be safely accomplished in an open lab, with no need for PPE since the experimental set up could be considered as Class 1 under local controls. **Reference**

  We are making the paper "*Zeroth Responders - LSO's Reporting Non-Compliant Lasers –Why, How, and to Whom - A step by step guide*" and the Suspicious Laser Product Protocol, or "SLaPP" available to the general laser-user community- hosting it as an open source resource on the public access area of **JHU** . Please join us in documenting your stories relating how you used the process and were able to implement appropriate administrative and engineering controls to ensure systems in your user community were both safe and compliance, so others can take advantage of those lessons learned. After being reviewed and sanitized the stories will be published for others to utilize. The three stories briefly described here are already published on that site.

View the SLaPP model on the next page.



Nathaniel Leon

Niel Leon is currently the Laser Safety Advocate for the Johns Hopkins University, Homewood Campus, where he has been instrumental in upgrading the laser safety program to facilitate the research objectives of JHU principal investigators by maximizing experimental controls and understanding, while implementing a culture of safety within the university's education pedagogy. He has over forty years of experience in mechanical systems design and support from product development and commercialization through to field support for both commercial and governmental sectors. He also serves on several Z136 subcommittees.

Scott Wohlstein

Scott Wohlstein is the President of The Photonics Group. He is a noted researcher and patent holder and is widely sought after for the design, development, and production of safe, US and EU compliant Photonics-based products and processes. He has nearly 40 years' experience enabling him to assist from one-person commercial start-ups to various branches of the US and foreign governments in areas such as R&D/D management, safety/risk, and troubleshooting. He has served on the editorial advisory board for Lasers & Optronics, editor for Measurements and Controls, and serves on several Z136 subcommittees.

WANT TO SHARE YOUR IDEAS WITH THE LASER COMMUNITY THROUGH *LIA TODAY*?

LIA TODAY

Check out the guest article guidelines below and get in touch with an editor today!

BEFORE YOU SUBMIT:

Content: We are always looking for great newsworthy content that covers challenges and innovations in the field of photonic materials processing, laser safety, and laser market trends. This is not a paid opportunity, but does carry the benefit of publishing your work on a platform that is read by thousands of your peers. All article topics should be confirmed with an LIA TODAY editor before writing your article. Please email your article ideas to liatoday@lia.org and an editor will be in touch with you.

Potential Categories: Safety, medical applications, research and development, laser applications fundamentals, history, business, and other categories.

Potential Industries: Energy storage, aerospace, DoD non-aerospace, automotive, medical devices and biotechnology, microelectronics and IC fabrication, Internet of Things, research and development, and other industries.

SUBMISSION GUIDELINES:

Style: The tone should be editorial and informative; it should not sound like a sales pitch. It should be comprehensible by a broad audience of readers with low to expert experience with the topic, so it is important to include examples and simple explanations alongside any technical language.

Length: 600 - 1500 words

Text: Please use standard fonts such as Arial, Calibri, or Times New Roman. Fonts, font sizes, and line spacing will be reformatted by LIA for the final piece. Grammar and mechanics will be edited to the LIA style guide by LIA, but please be mindful of spelling and grammar as you are writing so that your message is clear.

Headline: Please include two newsworthy headlines suggestions for your article using action verbs.

Images & Figures: Please include images to be used with the article. Submit as an email attachment (PNG, GIF, JPG, JPEG) (min. 1000px in width or height). Images should also be placed in the body of the text where the author would like them to appear in the final article. All figures or images should include captions.

Deadlines: All material is due no later than two weeks prior to the scheduled publishing date. Check with an editor for your deadline.

Note: LIA reserves the right to abstain from publishing a submitted article for any reason.

SUBMISSION CHECK LIST:

- Full text as a Word Document
  - Abstract: A 50 – 100 word summary in plain language
  - Two (2) headline suggestions using an action verb
  - Article 600 – 1500 Words
  - Images with captions placed in the body of the article
  - Article references when applicable
  - Short author *bio* (full title, company, 50 words)
  - (optional) Professional headshot of author
- Images attached in one of the accepted file types (.png, .tiff, .jpeg, .jpg) (min. 1000px width or height).

VIEW SUBMISSION FORM

The 2019 **International Laser Safety Conference**

This year's International Laser Safety Conference (ILSC) was the largest to date, bringing attendees from all around the globe to share knowledge about the future of laser safety. The 2019 conference brought back old favorites such as the FDA panel and discussion, and introduced new experiences through industry partners, such as a ride-along with Luminar to learn about their LiDAR technology. Throughout the week members of various ASC Z136 subcommittees met to discuss progress on various standards for the safe use of lasers. Check out some highlights from the conference below:

01 ILSC attendees caught up with old friends and networked with new acquantences at the Awards Luncheon on Monday.

02 Brad Jacobson (right), CMLSO Richard Gama (center), and other representatives of Agiliti Inc. accepted one of the two BLS Illumination awards for 2019.

03 CLSO Jamie King was the recipient of the R. James Rockwell, Jr. Educational Achievement Award, and also represented the second recipient of the BLS Illumination Award, Lawrence Livermore National Lab.

04 Robert J Thomas (center) of the U.S Airforce Research Laboratory received the 2019 recipient of the prestigious George M. Wilkening Award. Congratulations! Also pictured are ILSC General Chair, Benjamin Rockwell (left) and LIA Executive Director, Nat Quick (right)

05 Panels at ILSC included discussion of the diversity of laws and regulations for laser safety, as well as the impacts of LiDAR on safety and policy.

06 The first-ever ALSE award recipients shared how their companies support laser safety. Mount Sinai Medical Center was surprised with also being awarded the first-ever David H. Sliney Award for excellence in laser safety.

07 The standing-room-only closing plenary wrapped up the conference with several presentations and was followed-up by the ever-popular ice-cream social!

ILSC®
INTERNATIONAL LASER SAFETY CONFERENCE

LIA Rolls Out
New & Enhanced
ICALEO for Fall 2019

This year The Laser Institute (LIA) is proud to once again host the International Congress on Applications of Lasers & Electro-Optics (ICALEO) in Orlando, Florida, which runs October 7-10, 2019. What first started as the 1981 Joint US/Japan International Laser Processing Conference in Anaheim, California is now the largest conference of its kind in the Western Hemisphere, running for the 38th consecutive year this fall.

Focusing on the advanced uses of industrial lasers, last year's ICALEO attracted a record-breaking number of attendees from twenty-three countries. In response to a considerable mandate from its members and past ICALEO participants, LIA has modified its conference format to enhance the attendee experience and improve ROI for sponsors and exhibitors. ICALEO 2019 will feature 4 industry-specific conferences that will become the core focus of each day: Aerospace, Medical Devices & Life Sciences, Microelectronics, and Automotive. The improved conference structure will build on the traditions of the technical conference while driving commercial value for sponsors and exhibitors. Additionally, LIA will actively support the development of its sponsor and member networks before, during and after the event.

Each of the industry foci will have its own Business and Technical Plenary Session, Business Conference, and Evening of Innovation Symposium. The ICALEO Technical Conference and its workshops will span across the 4 day conference with some emphasis on each of the focused industry verticals as well as other notable industry applications. This change in program structure has resulted in significant interest from the end-user community and their tier 1, 2 and 3 suppliers. Based on demand to date, LIA anticipates the attendance of over 100 end-users and suppliers and over 1,000 conference participants.

ICALEO's technical conference and workshops will be subdivided into five technical tracks: LAM, Battery Systems and Energy Conversion, Micro, Macro, and Nano. In addition to the traditional format of the technical conference, these tracks will accentuate laser technology advancements within the 4 covered industries. Leaders and experts from the field of material interaction will also be presenting cutting-edge results of their research in these technology spheres for high impact applications.

The Business Conference will consist of an industry-focused tradeshow revolving around innovative photonics materials processing solutions specific to that industry. Sponsors and Exhibitors now enjoy a unique opportunity to concentrate their efforts each day on one of these top 4 industries. Tradeshow participants will have the ability to present their unique solutions to focused representatives of these supply chains.

The tradeshow will connect all members of the marketplace and include ICALEO's Live User Solutions Forums and Evening of Innovation Symposiums. These new mediums will allow manufacturers/integrators and suppliers to selectively engage in the discussion of unique challenges and revolutionary applications for advanced materials processing. Subject matter for this dialogue will be presented by prominent members of the user and manufacturing community.

Once again, LIA will present the 2019 Arthur L. Schawlow Award for Pioneering Basic and Applied Research in Laser Science and Engineering at ICALEO. However, it will also be presenting industry awards to the user community for innovations in photonics material processing. This year's business and technical conferences will garner extensive media coverage. Interviews will be conducted at LIA's media booth throughout the event and distributed through social media and press releases during and following the event.

Please see our ICALEO 2019 Sponsor & Exhibitor Prospectus for more details on sponsoring and exhibiting at this event.

LASER PIONEERS

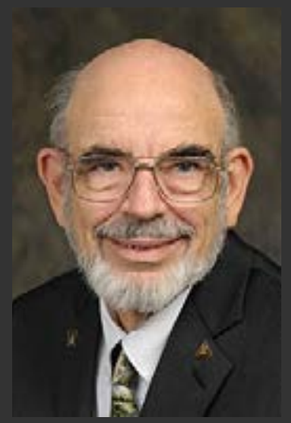
Interview with M.J. Soileau, Ph.D.

September 14, 2018
By Chrys Panayiotou, Ed.D.
Executive Director and Principal Investigator of LASER-TEC

Read Part-1 of MJ's story in the January/February issue of LIA TODAY

About the Author

Dr. Chrysanthos Panayiotou is the Executive Director and Principal Investigator of LASER-TEC, a National Science Foundation Center of Excellence in Laser and Fiber Optics Education. He is also a professor and chair of the Electronics Engineering Technology Department at Indian River State College, Ft. Pierce, Florida.



M.J. Soileau received his PhD in Quantum Electronics from the University of Southern California, and is currently a University Distinguished Professor of Optics and Photonics, Electrical and Computer Engineering, and Physics at the University of Central Florida. He is known for his pioneering research in nonlinear interaction of laser pulses with optical materials and for leading the development of the internationally recognized Center for Research and Education in Optics and Lasers (CREOL) at UCF. Soileau holds 6 U.S. patents, the applications of which have contributed to the advancement of high energy laser optics used by the United States Department of Defense. His leadership has helped UCF become a catalyst for the region's high-tech development, stimulating the local economy in central Florida. He is a Fellow of IEEE, the SPIE--The International Optical Engineering Society, and the Optical Society of America. M.J. has been honored as a Foreign Member of the Russian Academy of Sciences, inducted to the Florida Inventors Hall of Fame, is a Fellow of the National Academy of Inventors, received the SPIE Gold Medal Award, and the OSA Esther Hoffman Beller Award.

I talked to Dr. Soileau about his personal experiences in the early days of the invention of the laser and his journey through the last 60 years of laser history.

Part 2

CP: How did you go from there to get your PhD and what did you do?

MJS: OK well, while I was defending democracy by playing with lasers at Kirtland, some friends of mine had a little start-up company on the side. So, these guys were literally moonlighting with a little company named MITS, Inc., Micro Instrumentation and Telemetry Systems. It was founded on the idea of making telemetry systems for model rockets. The company business plan was to write a construction article for Popular Electronics, for example, "Build Your Own Temperature Sensor for Your Model Rocket," and here's a list of parts. If you'd like a kit send money to this address, we'll send you a kit. If you want an assembled unit then send more money.

Well, I had an interest in optics and photography that went back from my interest in astronomy. So, my buddies asked me to take some pictures for our brochures, and I did. Then they asked me to join the company. I questioned them about what they needed a physicist for, etc. The answer was, "Don't worry. Join us and we'll have a lot of fun and maybe make some money". I decided to join MITS part-time.

At that time the Vietnam War starting to wind down. The Air Force started opening the window to let people out, because of a reduction in force mandated by congress. When it became wide enough for me to jump out, I decided to take the "early out" of the Air Force and go to work full-time for this company.

This part of my career may be instructive for young people. I'd been working for MITS for about 6 months, literally moonlighting. I would come home at 5 o'clock, have dinner with the family, go to the company, work until 12:30 in morning, come home, get up, and be at work at 7:30 am. I was vice president of manufacturing for MITS. I think that everyone there was a vice president, except for the people that I hired to stuff the bags for our kits who were all early release convicts (we had some subsidy from the state to hire them.) But when the word got out I was leaving the Air Force, I got a couple of unsolicited job offers, and it made me think a little bit. One of them was from the Naval Weapons Center at China Lake, California. I had worked with Hal and Jean Bennett while at Kirtland. Hal would become president of SPIE, Jean would become the first woman president of OSA. They were pioneers in the area of precision optics and had been classmates of Art Guenther's at Penn State University. Small world we live in.

Anyway, I'd been working with them and Hal called me up to offer me a job at China Lake, working in their precision optics efforts. I had great admiration for their work, in fact I had funded the work there as part of my job in the Air Force. This made me think about what I wanted to do. I was working very hard at MITS and it was not clear whether or not the company would survive. We didn't know about venture financing so we were funding it out of our back-pocket, hoping that we would get an order in so we could pay our vendors for the parts that we were buying and all this kind of stuff. Our most successful product at the time was a build-your-own four-function electronic calculator. First one available in this country and $250 real dollars in 1970. The competitor was a mechanical calculator that cost $1,500 dollars. These electro

mechanical machines multiplied by adding. If you wanted to multiply 125 by 125, you would have to add 125 to itself 125 times. Computers were around of course, but they were expensive, so that was our first successful product.

It wasn't clear if they were going to survive, but I found I was asking myself the wrong question. The right question was not whether it was going to survive, but, is that what I wanted to do? The answer to the first question was not obvious at all. The second question was absolutely obvious. No, I got suckered into that with my friends. I wanted to do science. I had an offer at a great science place, the physics division at the Naval Weapons Center at China Lake, California to do science. That's what I wanted to do.

CP: So we were talking about how you moved to China Lake.

MJS: Right.

CP: You started working for the Navy project.

MJS: Optics branch of the physics division of the Naval Weapon Center at China Lake.

CP: So, were you still an officer?

MJS: No, I left the Air Force. I was still a reserve officer, but I was removed from active duty to join the civilian world, and went to work there as a civilian scientists working for the Navy. The fact is, we are all working for DARPA those days, whether it was the Air Force or the Navy, and continued to work on some projects that were ongoing, that I had been involved with at Kirtland. The China Lake piece sponsored by DARPA had to do with optical materials. You had to be able to make surfaces that had the minimum possible absorption because, a little bit of a huge number is still a huge number. The question we addressed was how you control the absorption of an optical surface or optical film? This was another part of my education; the realization that you need to understand the fundamentals of what limits the absorption in the material. To understand those fundamental limits we had to develop polishing technology to get better surfaces, to get rid of the things that are not fundamental, shall we say. We had developed the ability to measure absorption at very small levels. The lasers that we were using in the work were not megawatt lasers, they were laboratory lasers, which meant we had a very little bit of absorption in a very big piece of optics. That turned out to be an interesting challenge. Therefore, the effort to understand the mechanisms meant you had to develop the instruments that you need to make the measurements, and from measurements we advanced science. That's what science is, right? We do experiments, [make] observations, and from that we come to theory, and with the theory suggest experiments and observations; you need to develop the technology so you can make these observations, and the process feeds on itself.

That was a great time in my education as well as my experience.
I was really hired by Hal Bennett to help them transition from block funding that the Navy was giving them, to a more industrial funding or competitive funding model. That means writing proposals to get funded. So I was hired to be a bureaucrat, just like at my Hanscom Field experience. But I was not satisfied with that, so I sold the program to DARPA that only I could do. They had nobody else to do it.

This is how I snuck back in the lab with this group of people that would never have hired me, probably, based on my research credentials because I didn't even have a PhD. All the scientist in the branch had PhDs.

I realized quickly that in order to do more basic science I had to have a better understanding of fundamental physics. I just had to understand the physics of what was going on better than I did, to do anything new.

I tried to do that on my own, to just get books and read, but that did not work. By this time, I had a family and work requirements. I decided that I needed to get a PhD. The Navy had a program to do that, and I ended up going to the University of Southern California to get a PhD in what they called quantum electronics in those days. At Stanford you'd call it applied physics, but the degree was offered through the electrical engineering department at USC, which was a huge department. Before that, I began my association with Michael Bass. Mike became my major professor. It was kind of funny when I contacted Mike about going to graduate school. He said, "What for?" I said, "To get a PhD." He says, "You don't have a PhD?" The answer was no. I think he then asked did I think I really needed one, since I had already published several papers. The answer was, yes, I do need one, because even though I was already doing research and publishing papers, I knew I had to understand science better in order to make more significant contributions.

> "This is how I snuck back in the lab with this group of people that would never have hired me, probably, based on my research credentials because I didn't even have a PhD. All the scientist in the branch had PhDs."

I went to graduate school after three years working at China Lake, which were very successful years, very exciting times, working with a very good group of people. Off I went to USC as a more senior graduate student. I had been out of college for nine years, so all the tools were rusty. However, I went there with my own grant from the Office of Naval Research. I did the PhD in three years. I'm not sure if it was record time, but there are many graduate students in the group that were there when I got there, and they were still there when I left.

I had a hard time the first year because I had to get back up to speed. I had to re-sharpen all the tools and all that. But once I did that I was way ahead of the other students because I had been working in the lab and I knew what I was going to do for my dissertation.

There were some great faculty, post docs, and students at USC. I would encounter [them] again in building CREOL. Mike Bass, who is now professor emeritus from UCF in CREOL, just retired this last year for a second time. Also Eric Van Stryland, who followed me as director of CREOL, and then became the Founding Dean of the College of Optics and Photonics. Later we recruited ST Wu, who does pioneering work in the area of liquid crystal displays. We were all in the same group at USC. It was a fun time to be there. Eric had just been hired as a postdoc when I started my PhD education. We worked together and he worked with me on my project. I provided some funding for Eric, and some funding for ST Wu. I finished in three years because I had a postdoc and two graduate students!

CP: The timeline,

MJS: Oh this is, ah let's see, yeah, arrived in Kirtland in '69, stayed there three years, then went to China Lake, and went to USC '76, and by '79 I was done, and back at China Lake. And meanwhile, right before I finished, Eric had been offered a job at University of North Texas, in Denton Texas, just North of Dallas. And it sounded like a good opportunity and we were closer to the same age than I was with my fellow students, if you like. Eric had gotten his PhD with Marlin Scully at University of Arizona. But he had not worked nine years in-between like I had. He is two years younger than me. I had advised him to take the job at North Texas and he did. Fast forward a little bit, I was back at China Lake, they had another faculty position open and they were having a hard time recruiting people to come to Denton, Texas. So Eric remembered that I said, if it were me I'd take the job. So basically, Eric recruited me to go to North Texas.

I spent a total of seven years working at the Naval Weapons Center at China Lake. Three of those seven years I spent employed by China Lake, but working at USC, pursuing my PhD, in a group that was basically not so much a laser group, but an optics group, making optics for lasers. Initially they made optics before lasers came along, they made optics for things like the sidewinder missile, which was developed at China Lake, the first heat seeking missile. The military actually drove laser technology in those days. At Kirtland, AFB developed the neodymium YAG lasers that were shipped to Vietnam for smart weapons during that time period.

From all that fundamental work came a lot of practical things. There was pioneering work in solid state lasers, and diode lasers at Kirtland, AFB. During my China Lake period the laser fusion programs were going full speed, and there were two of them at the time. One of them was at Livermore, which still goes today. The other was at Los Alamos. Livermore had the YAG, Los Alamos had CO^2. We thought we were going to make laser fusion with CO^2 lasers. The good news is CO^2 lasers are about 10 times more efficient than neodymium YAG lasers. YAGs are about a percent optically [pumped] YAG lasers at the time. CO^2 was like 10%. But a factor 10 in wavelengths means a factor of 100 in the size of the optics, in terms of area.

And there was a talk I attended by one of the scientists at Los Alamos. He calculated how much optical surface area they would need to build a fusion laser with CO^2 at 10 microns. It exceeded the surface area of all optics that had ever been produced in the history of humankind. They were talking about mirrors, turning mirrors that were two or three meters along the long elliptical axis.

They had to develop new technology for doing that. That's where diamond turning was transitioned from nuclear weapons laboratories, where they were using diamond turning to make precision components for nukes, to making optical components. The driver for this transition was primarily the work at Los Alamos to make a fusion laser at 10 microns. They didn't have the same average power as the military did. However, they had high peak power, so they were using sodium chloride for windows instead of potassium chloride. But you still have to make them big, and stronger than single crystals. Therefore they alloyed NaCl with europium chloride. These were beautiful crystals with a kind of a blue tint. The europium would be excited by the fluorescent lights and fluoresce toward the blue.

At China Lake we did work on polishing and coating and laser induced damage to europium chloride, alloyed with sodium chloride laser windows for fusion lasers at 10 microns. Which, of course, were never to be. Anyway, all the work that was done at China Lake in those days was interesting,but as we develop new lasers we always encounter a problem with the materials. The second thing that happened with Maiman when he made the first ruby laser was damage to the laser materials. They put the coatings directly on the laser rods. If you were doing experiments in the old days with ruby lasers, you had to keep a ruby rod in your desk drawer, so you could replace the damaged rod. For whatever the reason, whether it's military lasers, or industrial lasers, or any other kind of lasers, you want to make the most compact device you can have, which means the highest power density possible, and that's always limited by what the optics will take.

The technology is associated

with thin films, and polishing, and coatings, and measurement of these things. This is the 50th anniversary, coming up in September 2018, of the laser induced damage symposium. Every new high power, or shorter pulse width, or whatever, you need to figure out how to make the optics in a way that won't blow up the laser before you even have a chance to use it.

> "If you were doing experiments in the old days with ruby lasers, you had to keep a ruby rod in your desk drawer, so you could replace the damaged rod."

I left the Navy in 1980 to join the University of North Texas. We formed a small group of people in the physics Department called the Center for Applied Quantum Electronics, CAQE (CAKE) as we called it. We eventually had seven faculty members in the group. I've never had more fun in all my life. I was teaching, I was doing research, we had some

interesting students and things were going wonderfully. Then the administration of the University changed, and without getting into the gory details, let's say they hired a provost for the University that was mentally unstable. It became impossible to stay there.

While that chaos was going on, I saw an article in Laser Focus, something about a new program called CREOL at a place called University of Central Florida in Orlando, FL. I called the person that was interviewed for the article, Ron Phillips, here at UCF, who had reconceived CREOL. That ultimately led to me being hired as the first director of CREOL and

arriving in on Jan 2. 1987.

Seven years at North Texas were very productive. I must say, very wonderful years, doing work in laser damage, and we also got into non-linear optics in general. Damage is a very non-linear process. We were looking specifically at self-focusing and multiphoton absorption. This lead to work in optical power limiters for sensor protection. That work is continued on until today. It is a very difficult problem. But the group at North Texas was very productive. I loved it there, the little country university town. We got integrated with the community, had no intention of ever leaving.

However, the world changed. We had a place to go with a clean slate, and I came to interview at UCF in '86. I wasn't sure about the place. There were around 15,000 students here at the time, most of which were commuters. I sent Eric, my colleague that had recruited me to North Texas, to go and have a look. He came back, he said, you got to be kidding me, though he didn't use the word kidding. "That's not a University. It is a glorified Community College. You can't be serious about going there", he said. But the long and the short of it, things were getting bad at North Texas. We had to go somewhere.

I took the job anyway and that was some rough going in those days. Old guys like to speak of the hard times. You know, walking uphill in the snow both ways, and all that kind of stuff. But, as with all of my career, that pathway was made better by having good senior mentors around. In this case, it was the late Bill Schwarz. Bill Schwarz is really the grandfather of the laser and optics industry in Florida. Bill was, really, very instrumental in the establishment of CREOL.

We had an almost-encounter with each other when I was a junior officer at Kirtland because I had the responsibility of developing polishing coating technology for the high power lasers. It was decided that we needed to have an optical shop at Kirtland to refurbished optics. The company that won that competition was International Laser Systems, which was Bill Schwarz's company. That bit of history I only learned after the fact, after arriving at CREOL.

Everybody assumes that I came up with the name CREOL, Center for Research Education Optics and Lasers, because I'm an eighth generation Creole person. That's absolutely not true. I think between Bill Schwarz and Ron Phillips, they came up with the acronym. Then they searched the world over to find a Cajun that could spell optics. I was the only one they could find, that's how I got the job (okay that is a joke!) So the rest is history.

So we came here, we were given a suite of four offices and a double wide trailer, 15 faculty positions to fill, and told to go out and do great things. It was kind of stupid to think that we were going to do that, but we did anyway, you know. And there was a big problem with the [number of] facilities. The University still hasn't gotten over this problem with facilities, and it now enrolls

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68,000 students, the largest University in the country. The only undefeated team in division-one of the NCAA, UCF Knights. And still undefeated, alright.

But anyway, at the time it was a very immature place. They had only a PhD in engineering, no PhDs in physics or mathematics or anything. And so, it was a University under construction. That was the bad news. The good news, because of that, we were kind of left alone. They didn't have any room for us on campus, so we rented space in the research park adjacent to the University, built out the space ourselves. And we were left alone to do our work.

And boy we did, we did work. We worked very hard. The main part of the work was recruiting top people. The rest doesn't matter. If you don't have the right people, it's just not going to matter. We had seen what had worked at Arizona. We had seen what had worked at Rochester. We had some models to look at. We didn't try to copy them. We didn't try to imitate them. But we did emulate them. The common denominator was optics. Since we have the word laser in our name, we have a little bit more emphasis in lasers than either of those two earlier programs had, and still do. We did it our own way, but having the idea that really came initially from the Institute of Optics and then from the Optical Sciences Center: put people from a variety of disciplines with the common denominator being optics. So you have people in electrical engineering, you had people in physics, you have people in material science, you sometimes computer science, and so on, and, but all interested in optics.

One of the secrets of successful graduate programs at universities in US, is not so much that the faculty collaborate with each other, you'd like them to do it, but you also require them to be independent. However, what always happens, the students collaborate. They talk to each other all the time, they learn from each other all the time

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We didn't invent the idea, the institute of optics did first. Copied by University of Arizona Optical Sciences, and copied by us. So you have people that are working on the fundamentals of the discipline, and other people producing, basically, prototype systems that are delivered to customers. Here's the key, sometimes those people are the same person. You have people that are working on fundamental physics, but also making the systems and delivering the systems to a customer. What the students learn from that, is the fundamentals of the discipline, and they also learn what it means to put together a piece of equipment and to make it work. This is a very good formula for learning for the students, and it makes them very marketable when they graduate.

CP: So there is a machine shop, or a fabrication shop here at CREOL, where they can build the prototype-

MJS: We don't have an optic shop to making our own optics. I have regretted that from day one. But, with finite budgets, finite everything, you have to make decisions. We do have a machine shop. In fact when I came in at 7:30 this morning, the first guy I ran into was the machinist. We have a formal program of the students to learn from the machinist, to operate the machines themselves, so they can go down into the machine shop. They have to be certified first, but, the machine shop is supposed to make things that you just can't buy off the shelf. It's a good rite of passage for the students to learn to deal with a machinist, because these are very skilled technicians.

And I learned that during my experience at China Lake. There's great respect for people that are technicians. I had the great opportunity to work with a technician very closely at China Lake. I would configure something in the experiment I was doing. The technician would come in and look at it and say: what the hell are you trying to do? I would tell him, and he would say something like, 'hm'. A few weeks later he would come back with something that was beautiful, that would do the job I was trying to do, but 10-times better than the kluge I had put together. Solutions that had beauty in it, both in its functionality and simplicity. I developed a great reverence for people that are sometimes called 'hands' people. We sometimes don't realize the spectrum of creativity among human beings. The skill people are very creative, because they figure out a way to implement what all these deep thinkers have thought about. And yeah, the PhD physicist could eventually make something that would work. But it wouldn't work as well, as something made by a well-trained technician. The creativity that comes from the technicians is very important to having success in doing real science.

> "The creativity that comes from the technicians is very important to having success in doing real science."

CP: So let's go back to CREOL.

MJS: Alright

CP: So you started CREOL in '87?

MJS: '87

CP: So fast forward we have '97, 2007, 2017. Boy, that's 30 years.

MJS: 30 years, yes.

CP: Tell us about the state of the laser industry and education in the decade of 1970 – 80 and how you founded CREOL at UCF.

Read the final installment of MJ's story in the May/June issue of LIA TODAY!

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