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Electro-Optics News, University of Dayton

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Director's corner



The year is being celebrated as the International Year of Light. On April 10, Electro-optics (EO), along with Physics and Electrical and Computer Engineering (ECE), celebrated with a day of events ranging from a PhD defense to various speakers on a wide variety of topics in optics (p.3).

The collaboration between EO and Air Force Research Labs (AFRL) continues to grow. Several new students will be funded this coming year from the Materials and Sensors directorates at AFRL. Four AFRL researchers have been granted graduate faculty status for supervising our students' theses and dissertation work.

In addition to AFRL, EO has been successful in bringing in funding from other organizations as well. Dr. Cong recently

received funding from the Army on the development of high resolution imaging of scenes with a large field of view (p.2). Very recently, Dr. Vorontsov received a significant grant to set up a distributed computing facility for atmospheric turbulence computations.

Our faculty have been active in research, mentoring graduate students and organizing international conferences. Dr. Haus, who received the UD Alumni Research Award this year, recently returned from China after the Nanophotonics conference. Earlier, he was in Mexico giving invited talks at Guanahuato University (p.3). I was in Shanghai at the Optical Society of America Digital Holography conference as the program chair.

Dr. Guru Subramanyam, Chair of ECE, organized the first and very successful workshop on Thin Films for Electron-

Partha Banerjee

ics, Electro-Optics, Energy and Systems at the University of Dayton China Institute. Dr. Zhan, member of the Center of Excellence for Thin-Film Research and Surface Engineering (CETRASE), was one of the general chairs.

EO is stepping up recruiting from other universities, both nationally and internationally. Dr. Sarangan represented EO at our annual visit to the University of Wisconsin at Platteville (UWP) in March. In addition to past and existing students from UWP, we have potentially two new graduate students joining our program, in addition to a summer intern. EO now has the first 4+1 BS-MS program student from Physics, Emily Erdman (p.4), in addition to two 4+1 students from ECE. We hope that the agreement with China Jilian University, initiated by Dr. Zhan, materializes in the near future, which should enable more MS students



Left: Brian Dolasinski (left) along with Jonathan Slagle (2nd from right) being honored at UD's Graduate Showcase on April 15, 2015 for outstanding PhD in EO and outstanding MS in ECE+EO, respectively. Right: Fares Almeahmadi, a receiving the outstanding PhD in ECE award from Paul Vanderburgh.

Keeping soldiers safe

May 2015
Graduates

Ujjitha Abeywickrema, PhD
Katherine Duncan-Chamberlin, MS
David Lombardo, MS
Shiyi Wang, PhD
Yang Xu, MS

Congratulations!

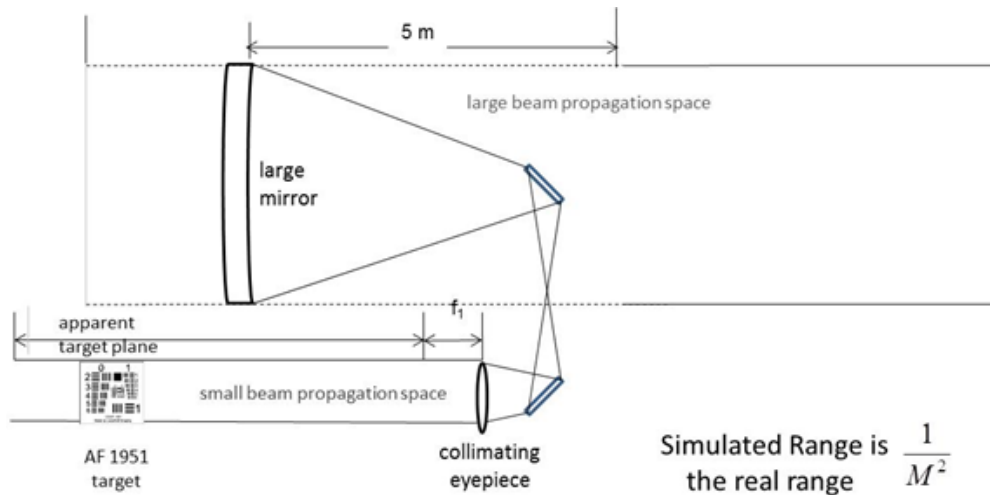


As a chief scientist responsible for the entire opto-mechanical system design, Dr. Cong Deng has been working with our industrial partner, Utopia Compression Corp (UC), for years to develop Very Large Field-of-View camera systems covering $360^\circ \times 200^\circ$. Recently they are finalizing a DARPA project, SB091-009 SBIR Phase II, called High-Resolution Imaging of Large Field-of-View Scenes. Their successful research has deeply attracted the attention of ARMY, therefore, their group won a new Army contract, A12-004 SBIR Phase II, called Novel Video-based Adaptive Intelligent Hemispherical Threat Detection System (HTDS). They kicked off this two-year project in September, 2014. They also are working on a system called Remotely Operated Weapon Systems (ROWS), which by design would keep soldiers away from hostile situations while they take on the enemy and thus

dramatically enhancing the weapon lethality and increase soldiers' survivability. Because current wide area threat detection capabilities for ROWS fall short of providing robust and continuous threat awareness, UC and UD are working on developing HTDS to support ARMY's vision for achieving smart situation awareness in ROWS, by providing real-time target detection and tracking, variable acuity of target resolution (triggered by threat level or user request), and threat recognition and alerting capabilities. The performance of the HTDS prototype will be tested onboard suitable vehicle platforms to evaluate its real-time wide area situational awareness capability in complex and cluttered operational environments. They hope to win Phase III for manufacturing product used in real situation after this work.

E0 down the range: Range hall simulates long distance propagation

EO has developed a facility called the compact range. According to Dr. Ed Watson, senior researcher in EO and UDRI, the idea is to simulate a longer distance while still being on an optical table. The compact range is a demagnification telescope which allows us to simulate longer ranges in our range hall. Dr. Watson currently plans on using a de-magnification of $40\times$. The simulated range is the magnification squared times the actual separation, so for example a 1.25 meter distance in our compact range becomes a simulated range of $1.25 \times 40^2 = 2000$ meters. Using a large mirror and this de-magnification he can simulate kilometers of distance in a meters long space (see notional schematic on right).



Notional schematic of the compact range.

In order to be able to simulate long ranges and to have more working space on the optical table, Dr. Watson's group is using 3 optical tables bolted together (see picture on the right). The length of the table is 28 feet! It consists of a 12 foot optical table, and two 8 foot tables with 6 inches of space between the tables, so the length from the front of the first table to the end of last table is 28 feet, 6 inches. If one had a 10-foot distance on an optical table, then using a magnification of 40, one could simulate a range of 16 Kilometers. With a 28 foot long optical table, one can simulate much longer effective distances.

Another interesting aspect of the compact range is that there is now a region where the optical path lengths are small and experimentally manageable. This can therefore be a convenient place to insert phase screens, because they can be smaller.

EO researchers Drs. Ed Watson and Paul McManamon, along with PhD graduate student Jeff Kraczek are involved with this important project.



The 28 foot optical table in one of the range halls in EO on the 5th floor of Fitz Hall.

UD celebrates International Year of Light

On 20 December 2013, the UN General Assembly 68th Session proclaimed 2015 as the International Year of Light and Light-based Technologies (IYL 2015). In proclaiming an International Year focusing on the topic of light science and its applications, the UN has recognized the importance of raising global awareness about how light-based technologies promote sustainable development and provide solutions to global challenges in energy, education, agriculture and health. Light plays a vital role in our daily lives and is an imperative cross-cutting discipline of science in the 21st century. It has revolutionized medicine, opened up international communication via the Internet, and continues to be central to linking cultural, economic and political aspects of the global society.

To help promote IYL 2015, UD hosted the International Year of Light Celebration on Friday, April 10th. This event featured a series of talks and seminars over a wide range of light-related subjects, with receptions throughout the day. The IYL Celebration started with the PhD defense by Ujjitha Abeywickrema, in which he successfully defended his dissertation, "Applications of induced gratings in nonlinear media." Congratulations to Dr. Abeywickrema on his successful defense! Our next event was an invited talk by Dr. Renjie Zhou, an EO

alumnus who is currently a Postdoctoral Research Associate at Massachusetts Institute of Technology, titled "Quantitative phase imaging: Metrology meets biology."



Dean Eddy Rojas welcoming the attendees to the IYL celebration at UD in the Torch Lounge at the Kennedy Union.

The IYL Celebration's main reception was held in KU Torch Lounge, hosted by Dr. Jay Mathews, Asst. Professor in Physics. Dr. Eddy Rojas, Dean of Engineering, was on hand to kick things off with a few words about the importance of light in today's world and UD's role in the development of light-based technologies. This was followed by a series of short talks exploring the use of light in vastly different areas: Dr. Ju Shen, Asst. Professor in the Dept. of Computer Science, gave a talk on the use of shading in computer graphics; Matthew Evans, Lecturer in the Dept. of Theatre and Technical Director of Boll Theatre, talked about the use of stage light-

ing in theatre production; Dr. Imad Agha, Asst. Professor in the Dept. of Physics gave a talk titled "Quantum Weirdness," in which he talked about strange phenomena arising from the quantum nature of light; and Dr. Sergei Lyuksyutov, Professor in the Dept. of Physics at the University of Akron, gave a presentation on supernovae and black holes.



Dr. Sergei Lyuksyutov discussing white dwarfs at the IYL celebration.

The Plenary talk was held in the Science Center Auditorium with a short reception and tours of the Physics department laboratories beforehand. Dr. Jeff Warrender, Physicist at US Army ARDEC-Benét Laboratories in Watervliet, NY, gave a very well-received presentation titled, "Seeing the (in)visible: The past, present, and future of light detection." His talk explored the methods for detecting light that have been used throughout history, starting with the eye and how it works, to photographic paper, to the development of semi-

conductor devices, and ending with his current research on infrared light detection.

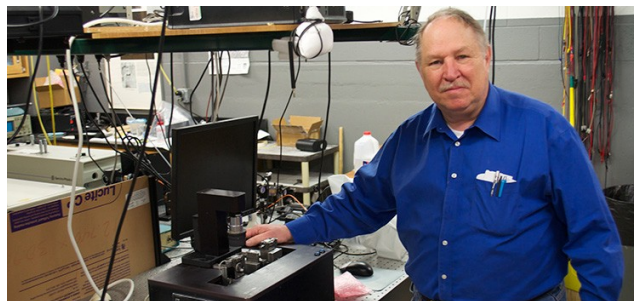
The IYL Celebration ended with a short reception at the EO offices. This reception also included tours of the Electro-Optics laboratories, and concluded the day's events with an assortment of desserts. The IYL Celebration events were well-attended, and this unique occasion helped introduce some new people to the exciting world of light.

The IYL Celebration was sponsored by Electro-Optics, the Department of Physics, and the Department of Electrical and Computer Engineering, as well as UD's chapters of Optical Society of America (OSA), the International Society for Optics and Photonics (SPIE), and the Society of Physics Students. Special thanks go to the organizers Sarah Krug, President of UD's OSA/SPIE chapter, Colleen Bransley, President of UD's SPS chapter, Drs. Imad Agha and Jay Mathews, Asst. Professors of Physics.

To learn more about IYL celebration at UD, please visit <http://www.light2015.org/Home/Event-Programme/2015/Other/US-University-of-Dayton-IYL-Celebration.html>. The general IYL site is <http://www.light2015.org/Home.html>

Faculty spotlight: Dr. Joe Haus

Since stepping down from the EO Director position, Dr. Haus has been as busy as ever delving into research activities with students. During an intense sabbatical year in Huntsville, AL in 2013, he developed a theoretical basis to study nonlinear electromagnetic scattering in nanoscale metallic structures in a regime where quantum tunneling effects should be observable. Recently he was awarded a grant from the Army Research Office with colleagues Andrew Sarangan and Imad Agha and in collaboration with Parag Banerjee at the University of Washington in St. Louis to develop experiments that can examine



Dr. Haus in a research lab in the Physics building.

the regime where quantum tunneling phenomena is dominant.

Dr. Haus recently received the UD Alumni Award for Re-

search in recognition for his career achievements. This spring he was invited to give several talks at two campuses of the University of Guanajuato in Mexico. About 100

students attended each talk. Last year two students spent 6 to 9 months in Dayton working with Dr. Haus on a research project. He has remained active in outreach by participating in the annual Techfest weekend at Sinclair Community College and he mentored four minority undergraduate students and one student from Chiapas, Mexico. In addition to all these activities he was elected as Secretary/Treasurer of the Division of Laser Sciences a unit of the American Physical Society. This caps off a year of intense research activities that do not seem to be abating with time.

EO @ UD A joint initiative between electrons and photons

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Summer in EO means short courses are back July 6-24, 2015

QUANTUM OPTICS July 6-10, 2015 Instructor: Dr. Imad Agha 1 Credit Hour

Introduction to quantum photonics and quantum information processing. Photons and quantum states of light; qubits and their manipulation via quantum gates and circuits; quantum information models; quantum computing; quantum cryptography. Pre-requisites: undergraduate-level electro-magnetic theory, basic quantum mechanics.

INTRODUCTION TO ATMOSPHERIC OPTICS July 13-17, 2015 Instructor: Dr. Mikhail Vorontsov 1 Credit Hour

Fundamentals of atmospheric physics, global and macro optical effects; atmospheric optical turbulence and its impact on imaging systems; atmospheric optical systems modeling and performance analysis; laser beam propagation in atmosphere, mitigation and exploitation of atmospheric effects.

OPTICAL DESIGN WITH ZEMAX July 20-24, 2015 Instructor: Dr. Cong Deng 1 Credit Hour

Introduction to ZEMAX and development of fundamental skills for designing practical optical systems. Project design with ZEMAX, using database of sample files; discussion of several real typical design projects. Includes discussions and help on students' ongoing projects, two-month assess to ZEMAX (Premium Version), and follow-up discussions.

We are on the web:

www.udayton.edu/engineering/electrooptics_grad/

Student spotlight: Emily Erdman



Emily Erdman, our newest student in Electro-Optics, joined the EO program in the Spring semester of 2015 as part of the 4+1 combined Bachelor's/Master's program. This accelerated program allows a student to complete a B.S degree in physics or an engineering discipline, plus a M.S. in Electro-Optics in just 5 years. Emily is the first student to have done this program with the combination of Physics and EO. Emily will graduate with her B.S. in Physics this summer, and she is on track to graduate with her M.S. in Electro-Optics in the summer of 2016. She is currently working on her Master's project with her advisor, Dr. Jay Mathews, who is a professor in the Physics department and is affiliated faculty in EOP.

Emily was born and raised Green Bay, Wisconsin. She came to Dayton in 2011, when she started as an undergraduate at UD. When asked why she chose her undergraduate major as Physics, Emily says, "I've always had so many interests, even when I was a young girl. I used to call my-

self a bundle of contradictions because it seemed like none of my passions correlated with one another. However, when I got to high school I realized that I needed to start embracing my quirkiness instead of fighting it and trying to fit one mold of a person. I always liked to star-gaze and think about who I wanted to be, what direction I wanted my life to go in, and if I would ever figure out who I truly was. One day in math class my sophomore year, I thought about how cool it would be to actually get paid to stargaze while wondering and questioning life, the universe, and everything within it. I decided that day, as a 15 year old girl in her geo with trig class, to study physics. I've never looked back!"

The 4+1 program allows for intellectual development beyond just an undergraduate degree, and it gives students an opportunity to get hands-on laboratory experience in electro-optics, while increasing the students' skills and making them more competitive and marketable for the workplace. On this topic,

Emily says, "I wanted a deeper understanding of semiconductors, different kinds of electronics, materials, and optics. In this way, I would be able to truly make a great decision with my future- whether I wanted to go into industry, continue on to my PhD, or make it as a patent lawyer in the photonics industry."

Although it has only been one semester, Emily seems very happy with her choice to go down the EO path. In her own words, it has "allowed me to stay at UD and continue to work with some awesome people who truly had my best interests at heart and would always support me academically, professionally, and personally. The support I've had from my mentors at UD has been overwhelming and unlike anything I've ever experienced."

