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CHAIR'S CORNER by Partha Banerjee



As the celebrations for the International Year of Light drew to a close, the Electro-Optics Program was proud to celebrate a landmark event of its own. Effective July 1, 2016, the Electro-Optics Program became the **Department of Electro-Optics and Photonics (EOP)**. This required approval from the Department of Electrical and Computer Engineering (ECE), the Department of Physics, the School of Engineering, the Graduate Leadership Council, the Academic

Senate, the Provost, the President, and finally, the Board of Trustees. I want to extend my sincerest gratitude to all who made this possible. I would like to offer a special thank you to Dr. Perry Yaney, who was one of the founders of the Electro-Optics Program over 35 years ago, Dean Eddy Rojas, Dean Jason Pierce, Associate Provost Paul Vanderburgh and Provost Paul Benson. I would also like to thank Dr. Brad Duncan from Graduate Academic Affairs, Dr. Guru Subramanyam, chair of ECE, Dr. John Erdei, chair of Physics, and our faculty for making this happen.

As a new department, we look forward to increasing our enrollment in the graduate program. I am pleased to say that recently two important agreements have been signed with foreign universities/institutions to bring in high-quality M.S. and Ph.D. students to EOP.

The first agreement is with Huazong University of Science and Technology (HUST) in Wuhan, which is one of the top optics institutions in China. This is a result of personal connections of Dr. Cong Deng, research scientist in EOP, who is an alumnus from HUST. In addition to students from HUST coming to the University of Dayton, EOP will also be co-teaching courses at HUST in the coming years.

CHAIR'S CORNER Continued from page 1



EOP students and faculty, along with Dean Rojas, in Fitz Hall to celebrate the new Department of Electro-Optics and Photonics.

The second agreement is with Centro de Investigaciones en Óptica (CIO) in Leon, which is one of the premier optics research centers in Mexico. The arrangement with CIO is the culmination of visits to the University of Dayton by professors and students from the institution who came to work with Dr. Qiwen Zhan. We hope to get up to 5 M.S. students from HUST and up to 5 M.S. and 5 Ph.D. students from CIO in the coming academic year. Furthermore, we have established close collaborations, as well as student and faculty exchanges, with Universidad de Guanajuato and Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE) in Mexico.

The collaboration between EOP and Air Force Research Labs (AFRL) remains strong as several students continue to be funded from the Materials and Sensors directorates at AFRL. Dr. Imad Agha and Dr. Qiwen Zhan received a contract from AFRL Sensors to support a new graduate student Gary Severson in EOP. Dave Lombardo, a Ph.D. student in EOP, received an AFRL DAGSI award.

EOP has been successful in bringing in funding from other organizations as well. In addition to the existing MURI

and the DURIP grant on supercomputing, Dr. Mikhail Vorontsov recently received a prestigious NSF MRI award on 3D laser manufacturing. Dr. Jay Mathews received a Navy grant, and Dr. Paul McManamon received a Phase I, and now a Phase II, STTR contract from NASA on optical beam steering.

I am pleased to say that a new endeavor in the area of electro-optic crystal growth is under way. With \$200K support from Dean Rojas, and additional support from Dr. Paul McManamon, we are establishing the Center for Crystal Growth, Characterization and Applications within EOP. The goal of this is to produce electro-optics crystals for various optical applications such as beam steering, beam coupling and holography. In the long run, we wish to make these crystals available to researchers and other customers in the country. We are fortunate to have productive inputs from Dr. Ratnakar Neurgaonkar, formerly from Rockwell International, and an internationally renowned expert in this area.

Best wishes to all.

It is our goal to see the department grow to one of the premier optics institutions in the country.



SERVICE AND OUTREACH



Ph.D. students from across the nation at the School of Engineering's Academic Research Colloquium. They are pictured here at the Emerson Climate Technologies Helix Innovation Center for a tour of the facility.

Innovation Center. The goal of the meeting was to identify potential candidates for future faculty positions in SoE. This year's focus was Sustainability, Energy, and Environmental Engineering.

Along with Dr. Adam Fleischer from the National Institute of Standards and Technology, Washington D.C., and Dr. Jorge Pezoa from University of Concepcion, Chile, Dr. Partha Banerjee, chair of the Environmental Sensing Group of the Optical Society (OSA), organized the first Incubator Meeting in *Precision Measurements in Air Quality Monitoring: From Space Based Systems to Ground Based Point Sensors* at the OSA headquarters in Washington D.C., May 18–20, 2016. Researchers and experts from around the country and abroad participated in this two-day event. EOP faculty and Wright Brothers Endowed Chair, Dr. Mikhail Vorontsov, presented one of the keynote addresses. Further information can be found at the OSA blogsite: www.osa.org/en-us/the_optical_society_blog/2016/may_2016.

Dr. Dean Evans, graduate faculty of EOP, organized the 14th Annual Photorefractives Program Review Workshop in Sarasota, Florida, June 13–17, 2016. The workshop amassed prominent researchers from the U.S. and Europe to exchange research ideas and present their research. Igor Idehenre, Ph.D. student in EOP who works with Dean Evans at AFRL Materials Directorate, and Partha Banerjee attended.

Dr. Partha Banerjee was general chair of the OSA Digital Holography topical meeting as part of the Imaging Congress held in Heidelberg, Germany, July 25–28, 2016. Co-chair of the meeting was Dr. Wolfgang Osten from Institut für Technische Optik, Germany, along with program chairs Dr. Hoonjong Kang from Korea Electronics Technology Institute, South Korea, and Dr. Pascal Picart from Université du Maine, France. A record number of papers (170) were presented.

As part of EOP's recruiting efforts, Dr. Andrew Sarangan visited the University of Wisconsin, Platteville; Dr. Imad Agha and Dr. Jay Mathews visited Morehouse; Dr. Imad Agha visited Utah Valley University with an EOP graduate student Mike Buzbee, a UVU alumnus, and Brigham Young University.

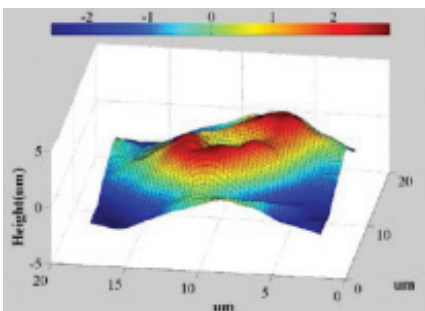
Dr. Qiwen Zhan gave an invited talk titled *Electromagnetic Fields with Subwavelength Antennas* at the IEEE APS/URSI conference in Puerto Rico in June 2016.

Dr. Partha Banerjee, along with Laura Bistrek, Director of Diversity in Engineering Center, and Meghan Brophy, administrative assistant in EOP, organized the first Academic Research Colloquium at the University of Dayton, April 19–21, 2016. The idea of this colloquium was suggested and supported by School of Engineering (SoE) Dean Eddy Rojas. Eighteen Ph.D. students from around the country, including six from the University of Dayton, participated in the three-day series of presentations on their research topics and attended many of the Stander Symposium talks. They also toured various research facilities in the School of Engineering, the GE Episcenter and Emerson Climate Technologies Helix



Dr. Ray Chen, Professor of ECE, University of Texas at Austin, in a selfie with Dr. Partha Banerjee at the OSA headquarters in Washington D.C. for the incubator meeting on Air Quality Monitoring.

ZHENYU YANG'S RESEARCH LEADS TO SMART PHONES FOR BIO-IMAGING



Reconstructed height map for red blood cell using smartphone-based wavefront sensor, based on research by Zhijun Yang (top).

Smart technologies and applications have been growing rapidly and dramatically changing people's daily lives. The vital components underlying these tools are the sensing technologies/data collection and the computing/data processing power. Palm-sized devices nowadays, such as smartphones, are embedded with a number of sensors and computing chips, which makes it possible to implement all types of functionalities that were previously restricted with traditional expensive and heavy-duty equipment. Towards this end, Zhenyu Yang (Ph.D., ECE, 2016) proposed and demonstrated equipping smartphones and their camera modules with optical sensors could be used to implement advanced sensing techniques that were formerly performed with conventional large-scale optical sensing tools. His research integrated optical sensing methods, such as microscopic imaging, polarization sensing and wavefront curvature sensing, onto a smartphone-based platform requiring very limited optical add-ons. The developed device shows the capability of detecting various micro-samples including bio-specimen, such as human blood cells, capturing a large amount of information far beyond just intensity images. The device is believed to have great potential in many application areas, such as healthcare and bio-imaging.

Zhenyu Yang's academic background is from multiple disciplines. He majored in software engineering at Nanjing University, China, and received his master's degree in computer science from Saint Joseph's University, Philadelphia. He then joined the Department of Electrical and Computer Engineering at the University of Dayton and Dr. Qiwen Zhan's (EOP and ECE) research team as a Ph.D. candidate, conducting research in smartphone-based miniature optical sensing. Dr. Yang is currently employed as a staff researcher in research and technology at Lenovo United States in Raleigh, North Carolina.

DEVELOPING AN INTEGRATED PHOTONIC BIOSENSOR CHIP

Integrated label-free photonic biosensors are well equipped for a plethora of applications because they provide an excellent means of detection together with the advantages of low cost and small sample volumes. David Lombardo, a Ph.D. student in Electro-Optics, recently won an AFRL/DAGSI award to develop an integrated photonic biosensor chip. Along with EOP faculty Dr. Andrew Sarangan and Dr. Imad Agha, he developed a waveguide-based sensor device that can be integrated with silicon electronics. The technology to integrate light sources, waveguides and photodetectors into a single chip is the key enabler for achieving compact, low-power and rugged platforms.

Lombardo joined the M.S. program in Electro-Optics at the University of Dayton in 2013 and worked with Dr. Shekhar Guha at AFRL in the area of nonlinear optics for his M.S. thesis. Since 2015, he has been a Ph.D. student in Electro-Optics. He recently passed his preliminary exam and is on his way to the proposal defense for his dissertation.



David Lombardo working in Andrew Sarangan's Nanofabrication Lab in the Science Center.

ELECTRO OPTICS IN ACTION



From left to right: Rudra Gnawali (PhD student), Ujitha Abeywickrema (research scientist) and Alexander Downham (MS student) working on digital holography in Holography and Metamaterials (HaM) lab in Fitz Hall 577; Dr. Mikhail Vorontsov in one of the labs at Optonicus; Ankita Khanolkar (PhD student) and Elaheh Ghanati (PhD student) aligning an optical setup at the Science Center; Diego Garcia (PhD student) working with a fiber laser in a lab at the Science Center.

PARTNERSHIP WITH INTERNATIONAL UNIVERSITIES: MOHAMMED ALMANEE REMINISCES ABOUT HIS TIME IN INAOE, MEXICO



For the past few months, I was engaged in a theoretical study of optical pulse polarization evolution as it propagates through a twisted fiber. Dr. Haus and I were trying to understand experimental results published a few years ago on the twisted fiber systems. We did not obtain expected agreement between the theoretical and experimental results, and Dr. Haus thought a visit with the experimental group would clear up the issues. The group was located at the Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE) in Tonantzintla, Mexico, so began a two-month sojourn to a new land. There I met the research group of Dr. Baldemar Ibarra-Escamilla and Dr. Evgeni Kuzin and participated in their experiments, an

essential collaboration to understand the pulse evolution process in more detail. Fortunately, with the help of the department, I had the chance to travel to Mexico for two months and setup the experiment again.

The fiber laser used in the experiment produced different pulse outputs, single and paired solitons, depending on the pump power. After amplification, the pulses propagated through a 500 m length of twisted fiber. We controlled the input polarization and determined the output polarization by separately measuring the orthogonal polarizations. The results improved in comparison with the previous ones. With better understanding of the experiment, I modified my code for a more faithful representation of the experimental conditions. Finally, the experimental results compared extremely well with my simulation results.

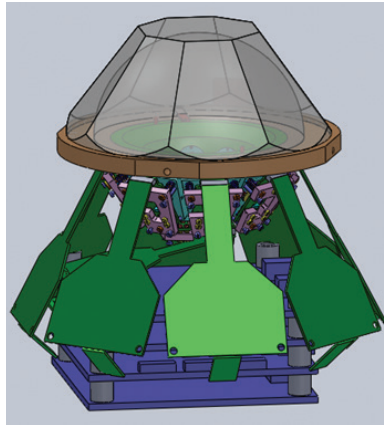
The outcomes are being prepared for submission to a journal very soon. I really had a very good time at INAOE, and my laboratory skills improved a great deal. I would like to take this opportunity to thank Dr. Haus and Dr. Banerjee for initiating this trip. I also would like to thank Dr. Ibarra-Escamilla and Dr. Kuzin and their student, Ivan Armas, for the wonderful support they offered at INAOE.

Mohammad Almanee (center), Ph.D. student in EOP from Saudi Arabia, along with researchers Dr. Baldemar Ibarra-Escamilla (left) and Dr. Evgeni Kuzin (second from right) at INAOE, Mexico. EOP and INAOE have many years of partnership in research; Dr. Joe Haus was recently awarded an honorary doctorate degree from INAOE.

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DARPA AND ARMY CONTRACTS PRODUCE UNIQUE CAMERA SYSTEM DESIGN



Dr. Cong Deng (left) and his “magic” camera (right).

Dr. Cong Deng, research scientist with Electro-Optics and Photonics, led a successful optical design SBIR Phase II project funded by DARPA. Resembling an extraterrestrial table lamp (see schematic, left), the optical system with nine cameras has a single viewpoint, covers a hemispherical field of view with no seams and less than 3 percent image distortion. The work was done in collaboration with UtopiaCompression, which has partnered with EOP for many years. Based in Los Angeles, UtopiaCompression (utopiacompression.com) is a high-tech company providing innovative and mission relevant solutions to U.S. government agencies and commercial markets. A modified

version of the DARPA design is fabricated under the auspices

of an Army SBIR contract that increases the field of view without sacrificing the image quality. Dr. Cong Deng and EOP faculty Dr. Joe Haus are engaged in transitioning a Phase III version of the system to a major aerospace company; discussions are in an exploratory stage.



EO GRADUATES MAY 2016



Michael Buzbee, M.S.

Yenfei Shen, M.S.

Yu Bai, M.S.

Yun Zhao, M.S.

Bradley DeShano, M.S.

Sichao Zhou, M.S.

Yining Liu, M.S.

Long Wang, Ph.D.



University of
Dayton

EOP is on the right track for reaching (its) goal of becoming an internationally recognized premier electro-optics program.

—Bahaa Saleh
Dean, The College of Optics and Photonics (CREOL)
University of Central Florida

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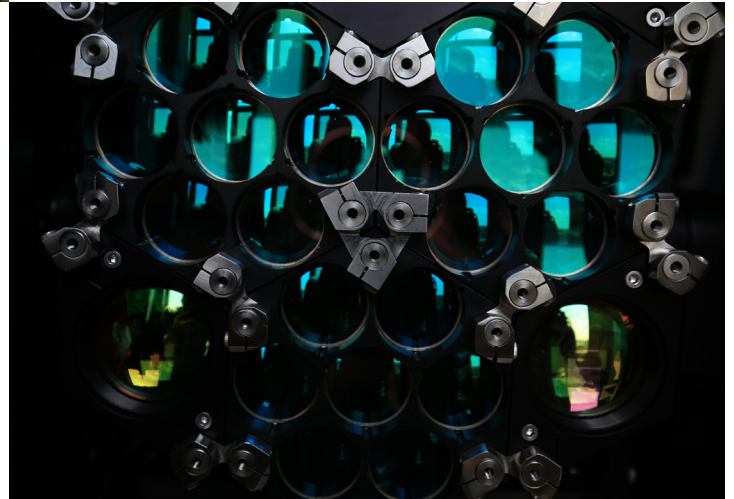
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