Welcome to 2020, the start of a new decade. This will be the last time I will be writing this column as Chair; our colleague, Andrew Sarangan, takes over the helm of EOP effective July 1. I wish him all the best, and I am sure under his leadership EOP will soar to newer heights. It has been a pleasure to learn, lead and serve for the past eight years, and I would like to express my sincere thanks to our students and my colleagues in the department, in Physics and ECE, at AFRL, those around the country, and around the world for making this possible.

Rather than reflecting on the past eight years, let me just summarize the events of 2019. As you know, Joe Haus passed away last January, leaving a huge void. We are in the process of filling his position and hope to have a specialist in LiDAR or additive manufacturing (AM). LiDAR along with Laser (assisted) AM (LAM) are hot topics these days, and the Dayton area has been traditionally an auto and manufacturing dominated region. The proposed areas will complement the expertise of Paul McManamon, who recently published a book on LiDAR and offers a highly successful short course in the area, and/or of Mikhail Vorontsov, who has been instrumental in introducing LAM along with his work on coherent laser beam combining and propagation through atmospheric turbulence.

We did well as a department last year. EOP generated over $1.7M in research expenditures. Through Cong Deng’s effort, six students from Huazhong University of Science and Technology (HUST) joined us as part of the 3+2 B.S. M.S. program. Two M.S. students and one Ph.D. student from Centro de Investigaciones Optica (CIO) joined as well as part of our joint program. Another M.S. student from HUST

Rainbow (Regnbogi) at Keflavik airport, by Ruri, an Icelandic artist. Extending 24m into the sky, Rainbow is the tallest artwork in Iceland, made of 313 yellow, red, green and blue stained glass pieces.

Photo credit: https://www.flickr.com/photos/loeldethomas/29285429001
REFLECTIONS CONT’D

received the dean’s fellowship. All of our HUST 2017 3+2 program students have graduated with their M.S., and Xuesong Gao and Yujie Yang are continuing here on their Ph.D., while Xiaowei Ge, Yuwen Li and Yunyang Li have joined Boston University, Texas A&M and the University of California in Davis, respectively for their Ph.D. Josh Burrow, our Ph.D. student working with Andrew Sarangan and Imad Agha, received the prestigious Ford Foundation scholarship. The EOP student chapter was one of a few around the world invited to present on their activities at the last SPIE Photonics West meeting. Our students presented papers at SPIE Photonics West and the OSA FiO meeting. As usual, our students also participated in TechFest, a very popular Dayton STEM event, started by Perry Yaney, one of the founders of this EO program. EOP also participated in the Women in Engineering summer program with weeklong, hands-on experiments in Andrew’s Nano-Fab Lab and my Holography and Metamaterials (HAM) Lab.

EOP faculty have continued to excel in research, which has been recognized nationally and internationally. Andrew continued his long-time collaboration with GenTex Corporation, a global automotive supplier of innovative, advanced technology for driver vision. Qiwen Zhan spent part of 2019 on sabbatical at Shanghai University of Science and Technology, where he is now recognized as a Distinguished Professor. Optonics, which is now part of II-VI, continues to expand, and is moving part of its operation to a new off-campus location where they will be hiring more optical engineers/scientists. Mikhail Vorontsov continued some of his atmospheric optics experiments in Hawaii; his work in conjunction with II-VI was featured in National Geographic — how cool is that!

Last summer, Pascal Picart from the University of LeMans and I co-organized the OSA Digital Holography conference in Bordeaux, France, which had a record turnout. I also helped Guru Subramanyam from ECE with the organization of TFE3S, his thin-films conference, in Reykjavik, Iceland. Other co-organizers of TFE3S included: Akhlesh Lakhtakia, an Evan Pugh University professor from Penn State and EOP advisory board member; and Karl Guðmundsson, a graduate from Wright State University and now a professor at the University of Iceland. And, Elena Stoykova, a professor from Bulgarian Academy of Sciences and Fulbright scholar, and Huilin Fang, an M.S. student from Shanghai University, spent three months at my HAM Lab working on digital holography.

We have received excellent reviews from our advisory board. The board, who met with us last March, noted:

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The EOP Department is an extremely tight-knit group of accomplished faculty members who are not only well regarded within their respective fields but also across the University and throughout the surrounding Dayton area... Taken together, these attributes enable the EOP team to support targeted research activities consistent with the University of Dayton’s long-term vision and provide ample opportunities for students to have a memorable and productive graduate experience.

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I end this column by borrowing from the words of noted CBS news anchor Walter Cronkite from his last broadcast: old (chairs) don’t fade away, they just keep coming back... with other assignments. And that’s the way it is — the start of a new chapter. Best wishes to all and warm regards.

Partha P. Banerjee, Chair, EOP

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A (NOT-SO) GLARING EXAMPLE OF INDUSTRY-UNIVERSITY PARTNERSHIP

Ever get tired of the nighttime glares from headlights of cars behind you? Usually you would need to flip the tab on your rear-view mirror, or with modern technology like the Gentex auto-dimming mirror, do nothing at all! And if your car does not come with this feature, you can simply add on – with some quick online shopping. Andrew Sarangan, who manages the Nano-Fab Lab, has a long-standing relationship and collaboration with Gentex, the leading manufacturer of automotive smart mirrors and displays. Gentex mirrors use sophisticated light sensors, proprietary gels and microprocessor-based algorithms to detect mirror glare and automatically darken to the precise level necessary to preserve driver vision.

Andrew, along with David Lombardo (Ph.D. student) and Dr. Pengfei Guo (currently employed at Silfex/LAM Research), worked with Gentex in 2019 to make their laser lithography technique adaptable to a large-scale manufacturing environment. Andrew and David visited the Gentex facility in scenic Holland, Michigan, in June 2019, toured their manufacturing facility and visited a Lake Michigan beach. Two of our past students also went to work at Gentex: Jian Gao, EOP, Ph.D., 2012, and Xiaoxu Niu, Materials Engr., M.S., 2010.

David, Andrew and Sheng (Gentex Corp.), Lake Michigan beach, near Holland.
The International Order of Holoknights was founded in 1988 by Dr. Hans Rottenkolber, a pioneer in the field of holography. One new member is selected annually based on their international recognition as a leader in the field of coherent optics and advocacy of international friendship. Previous holoknights include Charles Vest, ex-president of MIT; Jim Wyant, after whom the College of Optical Sciences is named at the University of Arizona; Eugene Arthurs, past CEO of SPIE; and Toyohiko Yatagai, past president, SPIE.

In congratulating Banerjee for this award, Jim Trolinger, CEO of Metrolaser and fellow Holoknight writes: “Sir Partha, you bring honor and achievement in the field to our unique organization and, equally important, a reputation for hospitality and promoter of international friendship and cooperation.”

In 2019, the Holoknight presentation was held in conjunction with the Optical Society's digital holography topical meeting in Bordeaux, France. Following tradition, Banerjee was “knighted” by the last year’s recipient, Pascal Picart.

“Being honored with this prestigious award was absolutely unexpected and a total surprise for me,” stated Banerjee. “I owe this to my parents and family, my undergraduate and graduate advisers, my students and all my colleagues from around the world whose help and support has been key to my work and this recognition.”

**THE NEWEST “KNIGHT” IN OPTICS**

In recognition of his contributions to optics in the field of holography, Partha Banerjee was inducted into the International Order of Holoknights — an elite group of holographers from around the world.

**LIST OF HOLOKNIGHTS**

<table>
<thead>
<tr>
<th>Year</th>
<th>Name and Affiliation</th>
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<tbody>
<tr>
<td>1988</td>
<td>Werner Jüptner, University of Bremen, Germany</td>
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<tr>
<td>1991</td>
<td>Ryszard J. (Rich) Pryputniewicz, Worcester Polytechnic Institute, USA</td>
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<tr>
<td>1993</td>
<td>Paul Smigielksi, Franco-German Research Institute at Saint-Louis, France</td>
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<td>1995</td>
<td>Jim Trolinger, Metrolaser, USA</td>
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<td>1997</td>
<td>Ole Løkberg, Norwegian University of Science and Technology, Norway</td>
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<tr>
<td>1999</td>
<td>Mitsuo Takeda, University of Electro-Communications, Japan</td>
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<td>2000</td>
<td>Malgorzata Kujawinska, Warsaw University of Technology, Poland</td>
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<td>2001</td>
<td>Wolfgang Osten, University of Stuttgart, Germany</td>
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<td>2001</td>
<td>Pierre Boone, University of Ghent, Belgium</td>
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<td>2002</td>
<td>Ichirou Yamaguchi, Gunma University, Japan</td>
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<tr>
<td>2004</td>
<td>Anand Asundi, Nanyang Technological University, Singapore</td>
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<tr>
<td>2005</td>
<td>Armando Albertazzi, University of Santa Catarina, Brazil</td>
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<td>2005</td>
<td>Rajpal Sirohi, Indian Institute of Technology, India</td>
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<td>2006</td>
<td>Vladimir Markov, University of Kyiv, Ukraine; currently at Metrolaser, USA</td>
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<td>2008</td>
<td>Charles Vest, MIT, USA</td>
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<td>2009</td>
<td>Nadya Reingand, Ioffe, St Petersburg, Russia; currently at Landon IP, USA</td>
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<td>2010</td>
<td>Fernando Mendoza Santoyo, Centro de Investigaciones en Optica, Leon, Mexico</td>
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<td>2011</td>
<td>Toyohiko Yatagai, Utsonomiya University, Japan</td>
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<td>2012</td>
<td>Cristina Yanez Trillo, University of Vigo, Spain</td>
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<td>2013</td>
<td>James Wyant, University of Arizona, USA</td>
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<td>2014</td>
<td>Byounghe Lee, Seoul National University, S. Korea</td>
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<td>2015</td>
<td>Pietro Ferraro, National Institute of Applied Optics, Napoli, Italy</td>
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<td>2016</td>
<td>Peter de Groot, Zygo Corp., USA</td>
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<td>2017</td>
<td>Guohai Situ, Shanghai Institute of Optics and Fine Mechanics, China</td>
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<td>2017</td>
<td>Eugene Arthurs, SPIE, USA</td>
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<td>2018</td>
<td>Pascal Picart, University of LeMans, France</td>
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<tr>
<td>2019</td>
<td>Partha Banerjee, University of Dayton, USA</td>
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SELECTED JOURNAL PUBLICATIONS

SELECTED JOURNAL PUBLICATIONS CONTINUED


SELECTED CONFERENCE PRESENTATIONS/PROCEEDINGS


RECENT EOP GRADUATES

MAY 2019

Jordan Adams, M.S.
Ph.D. student, EOP, UD*

Xiaowei Ge, M.S.
Ph.D. student, ECE, Boston U.*

Roseanna Lawandi, M.S.
Ph.D. student, EOP, UD*

Josh Duran, Ph.D.
AFRL, Dayton*

Ighodalo Idehenre, Ph.D.
AFRL, Dayton*

AUGUST 2019

Mark Easton, M.S.
AFRL, Dayton*

Xuesong Gao, M.S.
Ph.D. student, EOP, UD*

Yuwen Li, M.S.
Ph.D. student, ECE, Texas A&M*

Yunyang Li, M.S.
Ph.D. student, ECE, UC Davis*

Saleha Qissi, M.S.
Ph.D. student, EOP, UD*

Hongwei Chen, Ph.D.
Fuyao Glass, China*

DECEMBER 2019

Zachary Biegler, M.S.
Ph.D. student, Materials, UC Santa Barbara*

Kyle French, M.S.
AFRL, Dayton*

Yujie Yang, M.S.
Ph.D. student, EOP, UD*

John Hennen, Ph.D.
Defense Res. Associates, Dayton*

Congratulations!
*Current placement

2019 DEAN’S FELLOW: HAOWEN ZHOU

As reported in the last newsletter (2019), Remona Heenkenda, who joined our Ph.D. program, was the first recipient of the dean’s fellowship in electro-optics in 2018. In 2019, EOP gave the fellowship to Haowen Zhou, an M.S. student from Huazhong University of Science and Technology (HUST). Unlike the other HUST students who have joined us as part of the 3+2 BS-MS joint program between HUST and EOP, Haowen finished his B.S. at the School of Engineering Sciences at HUST before joining us last fall. However, in his last year of undergraduate study at HUST, Haowen came to UD and spent six months in Partha Banerjee’s group working on his undergraduate thesis. “During my stay, I was attracted to the EOP program. The courses here are well-organized, closely related to optical theory and applications. Moreover, working with world-famous professors as well as smart fellow students is of great joy. Therefore, I made my decision to pursue my master’s degree in EOP at UD.”

In research, Haowen works on holography and phase imaging with Partha Banerjee. He presented his work at SPIE Photonics West in 2019 and published two journal papers in Applied Optics and four conference papers. He was the first author in one of the journal papers. “UD and EOP offer me a great platform to reach out to the optics society in and out of campus. I have joined OSA and SPIE student chapters at EOP who organize invited talks, seminars, coffee talks and abundant activities very often. I’m glad I made the choice to study at EOP and hope to have a fruitful two-year study here.”

The dean’s fellowship will grow to support a total of three EOP students through their graduate studies in the long term.
EOP IN ACTION

From top left, clockwise: From National Geographic, March 2019, with the caption: A laser transmitter, like this one developed by II-VI, Inc. and the University of Dayton, presages the technology that Breakthrough Starshot needs to propel spacecraft to the nearest star; at the University of Iceland campus in front of the Union - from left: Monish Chatterjee, ECE, with Andrew Sarangan and Partha Banerjee; Josh Burrow, Ph.D. student and recipient of the Ford Foundation Fellowship, at his lab in the Science Center; Shuo Sun, Elforjani Jera and Haowen Zhuo at SFO after attending and presenting at the SPIE Photonics West conference.

EOP at 2019 OSA FiO. From left: Yun Zhao, MS ’16 and now PhD student at Columbia U., with Jay Mathews, Imad Agha, Roseanna Lawandi, Andrew Sarangan, and Shuo Sun.
HAWAII, A VOCATION PARADISE?

Imagine clear turquoise waters, beaches, surfing, volcanoes, Mauna Loa, Haleakala — that’s the dream trip to Hawaii that people think about. But frequently, EOP researchers Mikhail Vorontsov, Ernst Polnau and Thomas Weyrauch travel there to perform unique, atmospheric, long-range laser beam propagation experiments. Last year, they went to collect valuable data on laser propagation between the Mauna Loa and Haleakala summits, a distance of 150 km, under clear weather conditions during several hours after sunset on April 3–6, April 9, April 14 and April 15. The team utilized a polychromatic laser beacon system based on photonic crystal fiber and the optical receiver system specifically developed for these experiments. The measurements included synchronized in time recordings of pupil and focal plane short-exposure intensity distributions at 0.53- and 1.063-micron wavelengths using two 30 cm-aperture Cassegrain receiver telescopes equipped with multi-aperture phase reconstruction (MAPR) sensors. The polychromatic beacon also provided capabilities for 1-D and 2-D scanning of all beams, which allowed measurements of atmospheric turbulence-induced beam widening, displacements of beam centroids caused by refractivity and power-in-the-bucket (PIB) signal fluctuations at different offset distances from the center of the beam footprint. Recording of these laser beam characteristics were compared with simultaneous measurements of local meteorological data with weather stations and scintillometer measurements of the atmospheric turbulence refractive index structure parameter.

Analysis and classification of the recorded data revealed startling results: The first observations of coherent laser beam mirage, giant enhancement of turbulence strength and its impact on laser beam propagation in the vicinity of clouds, large variations of atmospheric refractivity and strong coupling of refractivity and turbulence-induced effects on laser beam propagation, horizontal and vertical anisotropy of laser beam widening over long range atmospheric propagation in presence of both turbulence and refractivity, and occurrence of giant spikes in received laser beam intensity due to turbulence.

No word on what Mikhail, Ernst and Thomas did to celebrate their achievements. Mai Tai, luau, hula dance? That information is classified!