

# EON

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Electro-Optics News, University of Dayton

## Faculty

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Qiwen Zhan

with

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Editor: Partha P. Banerjee

## Director's corner



The EO program is one of the most prominent and significant contributors to the national recognition of UD.

Since the publication of the last newsletter, EO has completed its graduate program review. As of 2012, we have over 50 students in our program. Our MS and PhD selectivities are 30% and 20%, respectively. EO has graduated 7 MS and 3 PhDs per year. Our research expenditures for the last 2 years was \$2.5M/year. Our principal EO faculty have averaged over 20 refereed journal publications and 25 conference papers per year. EO is also a "good citizen" of the University, providing a substantial net revenue and profit (about 40% in AY 2010-11 and 60% in AY 2011-12).

This year, EO has enjoyed an excellent batch of incoming students, which includes 60% of female students. Furthermore, 2

of the incoming students are being supported as TAs in Physics, while 4 are being supported as RAs through 2 year contracts from AFRL Sensors and Materials Directorates. We hope that this continues and grows in the years to come.

LOCI, the center of innovation in optics and lasers housed in EO, held its annual board meeting recently. The board approved the hiring of a new director for LOCI in its expanded role as a center for innovative technologies providing collaborative workspace for faculty and research staff at UD and partner institutions in conjunction with federal and private agencies, small businesses and large corporations, and students. It was decided that the Director must have a proven entrepreneurship record, along with a strong technical expertise and business experience, and is responsible for the continued growth and diversification of LOCI beyond its current

## Partha Banerjee

and successful mission of laser radar research.

Optonicus, a small business which spawned from EO, continues to grow. Just recently Optonicus (with UD) received notification that it won a phase II STTR on atmospheric sensing. Optonicus already has a couple of joint UD/Optonicus Phase I STTRs and one Phase II contract. Optonicus continues to support EO students and hopes to hire more in the coming future.

Professor Andrew Sarangan received the ASC award for research in April, and has been chosen to receive the SOCHE Excellence in teaching award. I am also delighted to say that **two** of our faculty, Professors Peter Powers and Qiwen Zhan, have just recently been elected to Fellow status of OSA. Between EO faculty and technical staff, there are now at least **19** Fellows of international organizations such as SPIE, OSA, IEEE and IoP. Congratulations!

## EO, ECE students receive SPIE awards



EO PhD students **Ujitha Abeywickrema** (l) and **Shiyi Wang** (r) received SPIE travel grants, and ECE PhD student **Tarig Algadi** got the Newport Award to present their papers at the August 2013 SPIE Annual meeting in San Diego. Here, Ujitha and Shiyi pose in front of the UD EO poster at the exhibit area featuring student chapters.



**Every breath you take...**

Dr. Cong Deng, EO, is working with Utopia Compression on a DARPA SBIR Phase II project to develop small pan-cameras and hardware for uniform, high-resolution, video-rate imaging of large field-of-view, dynamic scenes.

...(He)'ll be watching you! :)

*EO looks forward to increased collaboration with Sensors and Materials in the future, and other AFRL directorates as well.*

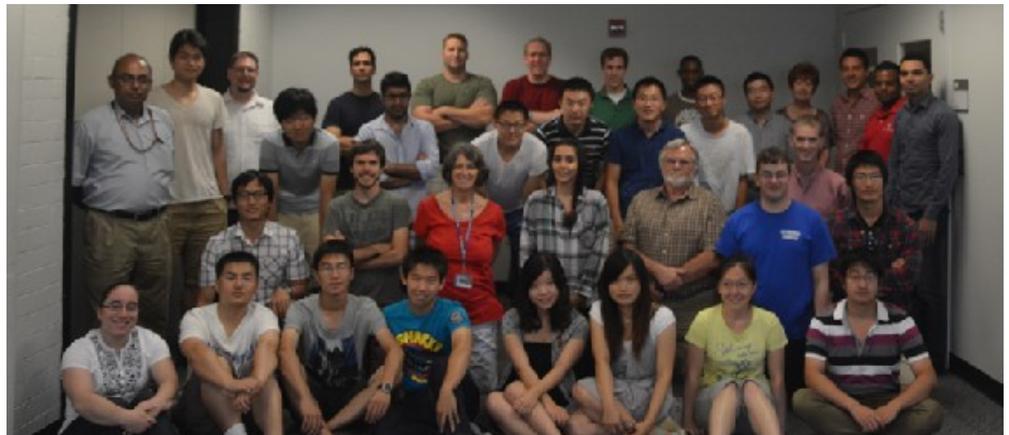
**SPOTLIGHT: New AFRL agreement supports EO students**

Under a new agreement with AFRL, the Sensors and Materials Directorates are supporting four of our graduate students for the next 2 years. This has enabled EO to attract top quality graduate students from around the US to the program this Fall. Three of those supported are new students in our MS program. They are Katherine Duncan-Chamberlin (John Carroll U.), Sarah Krug (Notre Dame), and Dave Lombardo (Rensselaer Polytechnic). The fourth student, Ighor Idehenre, recently completed his MS in EO and joined the PhD program.

The projects from the Materials Directorate comprise research on photorefractive materials, infrared materials, and optical measurements. Idehenre, who is working on photorefractive materials, has already started his research, working on the design and fabrication of novel hybrid materials for two-beam coupling and energy exchange. Lombardo's research work involves characterization of linear and nonlinear properties of materials from visible to infrared wavelengths, including thermal nonlinearities, and numerical simulations of beam propagation through these materials. Duncan-Chamberlin will be working on modeling of directional-hemispherical reflectance of opaque materials using integrating spheres, and experimental verification of the simulations at visible and infrared wavelengths.

The project from the Sensors Directorate involves research on spatial aperture synthesis for improved resolution during target identification and extended ranges. Krug's work will involve developing techniques which allow for spatial aperture synthesis to be achieved with reduced hardware complexity.

EO looks forward to increased collaboration with Sensors and Materials in the future, and involving other AFRL Directorates as well.



Electro-Optics faculty and students in a group photo-op outside LOCI, the Laser and Optics Center for Innovation, Fall 2013. 11 new EO students and 2 new faculty (from Physics) joined us this Fall.

**Nanotechnology class simulcast at UD, Sinclair**



Electro-Optics Spring (top) and Fall (bottom) picnics 2013. Both were held at the Hills and Dale Park.



UD EO professor Andrew Sarangan (above), along with Jamshid Moradmand (Sinclair) are teaching the undergraduate course in nanotechnology simultaneously at both campuses. Funded through a NSF grant, this is the second

time the course is being offered. Here Dr. Sarangan shows nanofabrication techniques from his lab at UD, while students at remote classrooms at UD (above) and Sinclair Community College (right) listen. Students have

the opportunity to interact with Dr. Sarangan on real time video. A second follow-up course is also offered. On a related note, Dr. Sarangan taught a graduate level short course on Thin-film engineering this summer.



## Selected journal papers

1. A. Gonza´lez-García, B. Ibarra-Escamilla, O. Pottiez, E.A. Kuzin, F. Maya-Ordoñez, M. Durán-Sánchez, C. Deng, J. Haus, and P. Powers, "High efficiency, actively Q-switched Er/Yb fiber laser," *Optics Laser Tech.* **48** 182-186 (2013).
2. J. Fu, Q. Zhan, M. Y. Lim, Z. Li, and H. Ou-Yang, "Potential energy profile of colloidal nanoparticles in optical confinement," *Opt. Lett.* **38** 3995-3998 (2013).
3. W. Han, Y. Yang, W. Cheng, and Q. Zhan, "Vectorial optical field generator for the creation of arbitrarily complex fields," *Opt. Exp.* **21** 20692-20706 (2013).
4. A. Liu, X. Xiong, X. Ren, Y. Cai, G. Rui, Q. Zhan, G. C. Guo, and G. P. Guo, "Detecting orbital angular momentum through division-of-amplitude interference with a circular plasmonic lens," *Sci. Rep.* **3** 2402 (2013).
5. G. Rui, D. C. Abeysinghe, R. L. Nelson and Q. Zhan, "Demonstration of beam steering via dipole-coupled plasmonic spiral antenna," *Sci. Rep.* **3** 2237 (2013).
6. W. Cheng, W. Han, and Q. Zhan, "Compact flattop laser beam shaper using vectorial vortex," *Appl. Opt.* **52** 4608-4612 (2013).
7. J. Hu, Q. Zhan, J. Chen, X. Wang, Y. Lu, and H. Ming, "Improving deep subwavelength imaging through terminal interface design of metallo-dielectric multilayered stacks," *J. Nanophoton.* **7** 073091 (2013).
8. B. Sun, A. Wang, L. Xu, C. Gu, Y. Zhou, Z. Lin, H. Ming, and Q. Zhan, "Transverse mode switchable fiber laser through wavelength tuning," *Opt. Lett.* **38** 667-669 (2013).
9. S. Derenko, R. Kullock, Z. Wu, A. Sarangan, C. Schuster, L. Eng, and T. Härtling, "Local photochemical plasmon mode tuning in metal nanoparticle arrays," *Opt. Mat. Exp.*, **3**, 794-805 (2013).
10. P. Shah, Z. Wu, and A. Sarangan, "Effects of CO<sub>2</sub> critical point drying on nanostructured SiO<sub>2</sub> thin films after liquid exposure," *Thin Solid Films*, **527**, 344-348 (2013).
11. M. Scalora, M. Vincenti, D. de Ceglia, M. Grande and J. Haus, "Spontaneous and stimulated Raman scattering near metal nanostructures in the ultrafast, high-intensity regime," *J. Opt. Soc. Am. B* **30**, 2634 (2013).
12. M. Vincenti, D. de Ceglia, J. Haus, and M. Scalora, "Harmonic Generation in Multi-Resonant Plasma Films," *Phys. Rev A* **1309.1363** (2013). arXiv 1305.5866.
13. L. Williams, G. Nehmetal, and P. Banerjee, "Digital tomographic compressive holographic reconstruction of three-dimensional objects in transmissive and reflective geometries," *Appl. Opt.* **52**, 1702-1710 (2013).
14. P. Banerjee, D. Evans, W. Lee, V. Reshetnyak, and N. Tansu, "Hybrid organic-inorganic materials for photonic applications," *Opt. Mater. Exp.* **3**, 1149-1151 (2013); co-published in *Appl. Opt.* **52** HM1-3 (2013).
15. M. Vorontsov, V. Dudorov, M. Zyryanova, V. Kolesov, and G. Filiminov, "Bit error rate in free-space optical communication systems with a partially coherent transmitting beam," *Atm. Oceanic Opt.* **26** 185-189 (2013).
16. J. Minet, M. Vorontsov, E. Polnau, and D. Dolfi, "Enhanced correlation of received power-signal fluctuations in bidirectional optical links," *J. Opt.* **15** 1-8 (2013).
17. S. Lachinova and M. Vorontsov, "Exotic laser beam engineering with coherent fiber-optic systems," *J. Opt.* **15** 105501 (2013).

## Selected conference papers

1. J. Haus, L. Li, N. Katte, C. Deng, M. Scalora, D. de Ceglia, and M. Vincenti, "Nanowire metal-insulator-metal plasmonic devices", *Proc. SPIE* **8883**, 888303 (2013).
2. J. Haus, L. Wang, P. Powers, and A. Sarangan, "Coherent super-position of multiple beams in a large mode area fiber", *Proc. SPIE* **8775**, 87750G (2013).
3. B. King, I. Idehenre, P. Powers, A. Sarangan, J. Haus, and K. Hansen, "Tapered optical fibers for aqueous and gaseous phase biosensing applications", *Proc. SPIE* **8570**, 85700G (2013).
4. A. Sarangan, J. Haus, S. Jain, J. Moradmand, and N. Reeder, "Collaborative Classroom Tools for Nanotechnology Process Education," *ASEE Annual Conf. #7689*, (2013).
5. S. Derenko, R. Wuchrer, A. Sarangan, C. Schuster, and T. Härtling, "Plasmonic gradient structures of nanoparticle arrays for optical sensing applications", *Proc. SPIE* **8693** (2013).
6. I. Agha, "Shaping single photons: Engineering the spectro-temporal properties of quantum-dot-based single photon sources," *invited*, *Phys. Sciences Symp. on Crystal, Graphene, Quantum & New Particle Phys.* (2013).
7. M. Vorontsov, "Conservation laws for counter-propagating optical waves in atmospheric turbulence," *Imaging and Applied Optics*, J. Christou, D. Miller, eds., OSA (2013).
8. J. Minet, M. Vorontsov, G. Wu, and D. Dolfi, "Efficiency comparison of spatial and spectral diversity techniques for fading mitigation in free-space optical communications," *Proc. SPIE* **8610** (2013).
9. P. Banerjee and U. Abeywickrama, "A simple optical probing technique for nonlinearly induced refractive index," *Proc. SPIE* **8847**, 88471O (2013).
10. R. Aylo, P. Banerjee, D. Evans, and S. Basun, "Contribution of diffusion and photovoltaic effect to self-pumped reflection gratings in LiNbO<sub>3</sub>," *Proc. SPIE* **8847** 88470B (2013).

## EO Graduates Spring 2013

MS

Mohammad Almanee  
Cullen Bradely  
Deigo Mina Garcia  
Bret Huggard  
Ighodal Idehenre  
Li Li

Summer 2013

PhD

Wen Cheng

Wei Han

MS

Benjamin Dapore  
Xiaodong Wang

### Congratulations!

*TWO of our EO  
faculty, Professors*

*Peter Powers and*

*Qiwen Zhan, have*

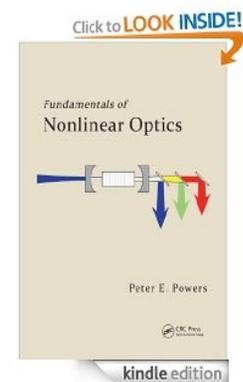
*just recently been*

*elected to Fellow*

*status of OSA.*

*Congratulations!*

## Recent books by EO faculty



Reading of Peter Power's *Nonlinear Optics* just got even easier, with the new Kindle edition. Now there is simply no excuse!

## EO @ UD

A joint initiative between  
electrons and photons



Institute for Development and  
Commercialization of Advanced  
Sensor Technology



Intelligent Optical Systems

## Food for thought

What are the two most important  
theorems in electromagnetics?



Dr. Haus (right) with Dr. Jim Wyant (ex-dean, Optical Sciences, U. Arizona) in Pattaya, Thailand, at the SPIE-OSA ICPS conference co-organized by UD alum Dr. Prathan Buranasiri, now faculty at King Mongkut University.

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Short courses kick off  
at EO for first time

The short courses on Digital Holography and Thin-film Engineering were offered for the first time at UD this summer. Dr. George Nehmetallah, UD alum and currently assistant professor at the Catholic University of America, and Dr. Banerjee co-taught the first course, while the second course was taught by Dr. Sarangan. It is hoped that these short courses, along with Lidar and Nonlinear optics, are offered in Summer 2014. These 5 day short courses can also be taken for 1 semester hour credit by graduate students. Typically the classes start Monday afternoon and end Friday at noon, with approximately 30 contact hours. Discussions are in progress with at least another university to offer these short courses at their campus in order to reach out to potential customers elsewhere in the country. It is hoped that more contemporary topics are offered as short courses in the future.

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In the next issue:

- SPIE Optics and Photonics global salary report
- Life after EO: What do our students do after graduation?

## Faculty receive awards, recognition



**Dr. Andrew Sarangan** (above) received the Dayton area Associated Societies Council award for research in April 2013. Recently, he was selected to receive the SOCHE Award for Teaching Excellence.

**Dr. Peter Powers**, Mann Chair Professor in Physics and EO faculty, has been recently elected to Fellow of the Optical Society of America. He is being recognized for "fundamental studies of nonlinear parametric interactions and for practical application to the development of optical parametric devices operating from infrared to terahertz regimes". Dr. Powers is also Fellow of the SPIE. His research centers on

nonlinear optical phenomena including optical frequency conversion, narrow-band and broad-band THz generation and detection, optical sensors, and remote sensing. He is the author of a recent textbook on Nonlinear Optics.

**Dr. Qiwen Zhan** has been recently elected to Fellow of the Optical Society of America. He is being recognized for "seminal contributions to the development of new optical polarization engineering techniques for controlling light-matter interactions on the nanometer scale". Dr. Zhan also recently became Fellow of the SPIE. He is currently interested in utilizing modern fabrication tools to achieve subwavelength spatial engineering of light wave properties and subsequently manipulate the light-matter interactions on the nanometer scale for nanoscale imaging applications.

## Selected Invited Talks &amp; Workshops



**P. Banerjee** (above), invited, workshop on "Digital Holography", Tripura University, India, May 2013; also, invited talk "Applications of Bragg and Non-Bragg orders in holography and interferometry" at International Conference on Photonics Solutions (ICPS), Pattaya, Thailand, May 2013.

**J. Haus**, invited talks "Quantum Conductivity and MIM nanoparticles", University Roma, Italia, July 2013; "Nanowire metal-insulator-metal plasmonic devices", at ICPS, Pattaya, Thailand, May 2013; "Nonlinear Optics: Potential US-Czech/Slovak Collaboration", NSF Int'l Workshop, Prague Apr 2013; "Specialty Optical Fibers for Lasers and Sensing", AMCOM, Huntsville, Feb 2013.

**A. Sarangan**, invited talk "Nano-structured Thin Films Using Oblique Angle Deposition: Synthesis, Optical Properties and Applications", University of Rochester, Feb 2013.

**Q. Zhan**, invited talks "Beaming and steering of photons with spin and orbital angular momentum using spiral plasmonic antenna", and "Tailoring optical complex fields with nanostructured metallic thin film" at SPIE San Diego, Aug 2013.