



Photo credit: Courtesy of Kionix, Inc.

## It All Makes Perfect “Sense” Now

An unexpected opportunity for ESM alum Tim Davis led him down a unique path to career success—one that many future ESM graduates may end up traveling along soon.



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Tim Davis ('86 E SC) did what most Ph.D. students do when they graduate—looked for a traditional research position. But an entrepreneurial-minded Cornell associate convinced

him to take a different career path, one that would have a significant impact on micro-electro-mechanical systems (MEMS) technology.

“Greg Galvin had just finished his MBA and discovered that Cornell had intellectual property around MEMS research that it didn't know what to do with,” said Davis. “He really wanted to start and run a company, and needed others to develop the technology. Although the MEMS field aligned more with my ESM degree than with my Ph.D. work, I agreed to be his partner.”



Photo credit: Courtesy of Kionix, Inc.

Davis and Galvin cofounded Kionix, Inc. in 1993 to commercialize MEMS, which are miniaturized moving devices such as sensors, mirrors, and actuators, made using semiconductor manufacturing techniques. At the time, only pressure sensors existed, but Davis and Galvin realized they could make motion sensors that measured acceleration and rotation.

“With the dot-com bubble in the late 90s, we were contracted to build a micro mirror that could move in two different directions and

redirect light waves from a fiber optic,” said Davis. “These micro MEMS were incorporated into internet switch boxes to help redirect fiber optic signals from one location to another.”

Building on their success, Davis and Galvin focused on the use of accelerometers and gyroscopes to develop 3D motion sensors that would eventually be used in laptop computers, gaming systems, and smartphones.

“We were the first company to measure three dimensions of linear acceleration using one sensing chip,” said Davis. “The most famous application of this technology is when your phone screen switches from portrait to landscape, depending on how you rotate it.”

Davis and Galvin sold Kionix in 2009. Davis retired this past January but continues to share his technical and entrepreneurial expertise with smaller companies and students.

“There's a lot of entrepreneurial activity in technology right now, and the economic model for engineers has changed,” said Davis. “We're going to see more startup companies hiring the types of engineers Penn State produces.”

It makes perfect sense to Davis to support that entrepreneurial activity.

“Graduates today have to be more adaptable because the career path they had in mind may not exist in five years. The more we can support that mindset, the more prepared graduates will be,” said Davis.



## Message from the Chair



A big thank you to ESM alumni Tim Davis, Tom Clark, David Perdziola, Marcy Perini, Mike Erdman, and Ben Ross, who gave awesome talks to our students. Let us know if you can visit in 2017!

Many alumni met the Society of Engineering Science Rube Goldberg team when they were the featured student group at President Eric Barron's fall tailgate.

Congratulations to our promoted faculty: Sulin Zhang, full professor; Patrick Drew and Reginald Hamilton, associate professors with tenure; Douglas Wolfe, senior scientist, Applied Research Laboratory (ARL), and professor; and Ted Reutzel, senior research associate, ARL, and associate professor. Zhang also received the Penn State Engineering Alumni Society Outstanding Research Award.



SES Rube Goldberg team

After 21 years at Penn State, Ardell Hosterman, mechanical research technologist, will retire on December 31.



Sulin (left), Ted, Reggie, and families at the President's reception for promoted faculty

Hosterman has been the mainstay of "all things mechanical," keeping our faculty and student research, and experimental laboratories, at the forefront of technology. We will truly miss Ardell and wish him and his wife, Janet, a very happy retirement.



Ardell Hosterman

Happy Holidays to you all!

*Judith A. Todd*

Judith A. Todd

## Faculty Spotlight

### Lakhtakia Garner Multiple Awards



In July, Akhlesh Lakhtakia, Charles Godfrey Binder Professor in Engineering Science and Mechanics, was awarded the 2016 Walston Chubb Award for Innovation by Sigma Xi, the Scientific Research Society. Lakhtakia was recognized for his theoretical and experimental innovations in electromagnetics, leading to the conceptualization and development of sculptured thin films (STFs) for novel optical devices and biomedical, biomimetic, and forensic applications. His research on STFs has led to the design of several types of optical devices including circular-polarization filters, spectral-hole filters, and circular-polarization vertical-cavity surface-emitting lasers.

Lakhtakia was also admitted as a Fellow of the Royal Society of Chemistry, based on his extensive and fundamental contributions to the optical response characteristics of isotropic chiral materials and to homogenization formalisms for composite materials and metamaterials.

## Graduate Spotlight

### Pena-Francesch Awarded for Innovation



Ph.D. candidate Abdon Pena-Francesch was awarded the Materials Research Society (MRS) Silver Graduate Student Award at the 2016 MRS Spring Meeting and Exhibit. His presentation, "Segmented molecular design of self-healing protein materials," focused on a new approach for designing the next generation of genetically engineered protein-based polymers (inspired by squid ring teeth) that can be repaired and reused.

Pena-Francesch also received the Rustum and Della Roy Innovation in Materials Research Award, which honors interdisciplinary materials research at Penn State that yields valuable, unexpected results and recognizes genuine innovation not previously achieved. His research involves a structural protein complex found in the tentacles of squid suction cups that exhibits remarkable mechanical properties in wet and dry conditions exceeding those of most natural and synthetic polymers.

## Undergraduate Spotlight

### McFadden Prepping for a Bright Future

During the summer, senior Ryan McFadden served as a supplier development engineering intern for SpaceX where he designed and developed a Tableau dashboard for outsourcing activity. He also served as a teaching intern in the fall, assisting with the E SC 414M course, an honors engineering materials class.



McFadden is completing his senior thesis under the supervision of Ibrahim Ozbolat, associate professor of engineering science and mechanics. McFadden is currently designing a method to mechanically evaluate in vitro and in vivo grown bone tissue to examine the biomechanical strength and viability of the new tissue.

Following graduation in the spring, McFadden will work for MPR Engineering Associates as a Power Group Engineer.



## 2016 Golden Decade Reunion

The annual ESM Golden Decade Reunion was held June 2-3, 2016, at the Penn State Conference Center, in conjunction with Penn State's Alumni Reunion Weekend. Approximately 40 ESM alumni, faculty, staff, and students attended the celebration banquet on Thursday evening to recognize ESM alumni who graduated in '66, '71, '76, '86, '91, '96, '06 and 2016. One individual was honored as a Golden Decade Fellow (50+ years alumni): Ed Heckman ('66).

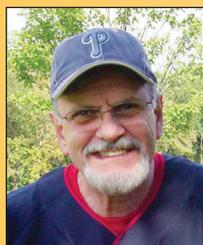
Friday's half-day program consisted of a state of the department by Judith Todd, department head; a faculty seminar presentation by Akhlesh Lakhtakia titled "About Birds and Bees"; a Meet & Greet with ESM students; and a "Meet the Dean" luncheon.

Next year's event will be held June 1-2, 2017. Contact Melissa Showalter at [mus41@psu.edu](mailto:mus41@psu.edu) to register.

## Alumni News and Recognition



**Ned Brokloff** ('82 E SC), chief scientist for Strategic Deterrence at Johns Hopkins University/Applied Physics Laboratory, made a generous donation to create the Ned Brokloff Endowment for Alumni Association Affiliate Group Innovation. Each year, the endowment's earnings—approximately \$1,350—will recognize and support a Penn State Alumni Association affiliate group that seeks new and creative ways to solve problems, fundraise, and unite members of its organization.



*Photo credit: Rutgers University—Camden*

**Paul Moré, Jr.** ('72 E SC), part-time lecturer at Rutgers University—Camden, continues to exemplify the leadership qualities Penn State ESM instills in its students. Having established the Moré Family Scholarship at Rutgers in 2007, which assists undergraduate students in their junior or senior year in the College of Arts and Sciences at Rutgers—Camden, Moré has helped more than 20 students earn their college degrees. He is also helping change lives outside the classroom through various charitable organizations.



*Photo credit: U.S. Air Force*

**Josh Park** ('14 E SC, '15 M.S. ESMCH), left, was promoted to First Lieutenant at the Munitions Directorate of the Air Force Research Laboratory (AFRL) at Eglin Air Force Base, FL. Park was also awarded the Air Force Achievement Medal for his work on an international

weapons program and was named the AFRL Munitions Directorate Company Grade Officer of the Quarter.



**Vijay K. Varadan** ('69 M.S. E MCH), Distinguished Professor Emeritus in the Penn State Department of Engineering Science and Mechanics, was conferred an honorary doctor of science degree from Saveetha University for his contributions in medicine, engineering, and nanotechnology. Varadan, cofounder and CMO/CTO of

Nanowear Inc., has concentrated specifically on the design and development of various electronic, acoustic, and structural composites, smart materials, structures, and devices that have helped develop neurostimulator, wireless microsensors, and systems for sensing and controlling diseases such as Parkinson's and Alzheimer's.



**William (Bill) Warren** ('86 E SC, '90 Ph.D. E SC), vice president and head of innovation in research and development at Sanofi Pasteur, was recognized in October with the lifelong title of Alumni Fellow by the Penn State Alumni Association. The award is the highest award given by the Alumni Association. Warren was one of 24 alumni

recognized as a 2016 Penn State Alumni Fellow.

### Attention ESM Alumni!

**What have you been up to lately?!** If you have some exciting news or a success story, we'd love to hear about it so we can share it with our community of alumni and peers.

Email [alumnirelations@esm.psu.edu](mailto:alumnirelations@esm.psu.edu) and give us the scoop!

## Graduate Programs

### Earn a One-Year Master's Degree from ESM

Led by our world-class faculty, our one-year graduate programs provide opportunities for individuals with degrees in engineering, science, mathematics, and related fields to expand their knowledge in engineering science and mechanics, engineering mechanics, and the growing field of nanotechnology.

Our programs are extremely flexible, allowing you to tailor your education to your personal and professional needs. ESM graduates are highly recruited by academia, national research laboratories, and industry while completing their graduate studies.

If you want to provide solutions to some of the world's most pressing problems, further your education, or improve your competitiveness

in the job market, you will have ample opportunity to do so with these one-year, interdisciplinary programs:

#### M.S. in Engineering at the Nano-scale

- Non-thesis program
- 30 credits
- Significant hands-on nanofabrication experiences

#### M.S. in Engineering Science and Mechanics

- Residence-based program
- 32 credits

#### M.Eng. in Engineering Mechanics

- Professional degree program
- 30 credits

Learn more at [www.esm.psu.edu/academics/graduate/one-year-masters-degree-programs.aspx](http://www.esm.psu.edu/academics/graduate/one-year-masters-degree-programs.aspx).



## Mixing It Up With the Best

On September 14, ESM held its annual ESM Recruitment by Industry Mixer in conjunction with Penn State's Fall Career Days. Held in the Earth and Engineering Sciences Building, it was another highly successful and rewarding event for both students and participating companies. More than 75 students and 15 companies attended the evening event. Students had the opportunity to interact with major companies including PWC, Intel, Merck, and SpaceX, with several students securing interviews at Career Days for internships and co-op opportunities. If your company is interested in participating in the 2017 fall mixer, please contact Melissa Showalter at [mus14@psu.edu](mailto:mus14@psu.edu) or 814-867-1569.

## Faculty Honors/Awards



### Das receives Young Investigator Award to improve 2D nanotransistors

Saptarshi Das, assistant professor of engineering science and mechanics, was awarded \$360,000 by the Air Force Office of Scientific Research (AFOSR) to work on contact engineering for nanotransistors based on two-dimensional (2D)

materials, which will improve the performance of electronic devices.

Das received the funds through the AFOSR's Young Investigator Research Program as part of his three-year research project titled "Investigation of Scalability and Reliability of Contacts to Two Dimensional Layered Semiconductors."

2D materials are drawing considerable attention as future candidates for energy-efficient electronic, optoelectronic, and energy-harvesting devices. Das is working to develop low-resistance, scalable, and reliable contacts through two methods: metal-2D interface engineering, which will use an ultra-thin, insulating 2D layer of optimal thickness between the metal and the 2D semiconductor, and metal-2D hybridization engineering, which uses high pressure to reduce the resistance.

Das will also investigate the characterization of metal-2D contacts under extreme operating conditions.



### ESM Researchers Awarded ASNT Fellowship

The research group led by Cliff Lissenden, professor of engineering science and mechanics, received a 2016 American Society for Nondestructive Testing Fellowship Award to

support its research on nondestructive inspection of materials and structures in harsh environments.

Lissenden and his group are working to characterize surface degradation, specifically pitting and stress corrosion cracking, through the development of a robot-delivered laser ultrasonics system for dry storage casks used for spent nuclear fuel. By using a pulsed laser coupled to an optical fiber and an innovative lens, the group is developing a system with the ability to operate in harsh, hazardous environments and confined spaces, providing an alternative to conventional contact or immersion techniques.

The robot-delivered laser ultrasonics system will also be suitable for other applications including pressure vessels, piping, and structural components for power plants.

# ESM Frontiers

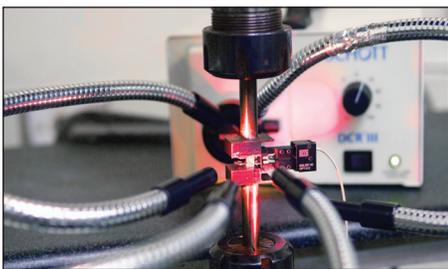
## The Shape of Things to Come

Reginald Hamilton's novel fabrication of shape memory alloys (SMAs) promises to have "memorable" impact on the construction, transportation, and health care industries.



Reginald Hamilton and graduate student Beth Last conduct thermal mechanical testing and digital image correlation for multiscale deformation analysis of an SMA.

Have you ever wondered whether we can make an aircraft wing that morphs like a butterfly wing; a wearable exoskeleton that keeps muscles from atrophying; walking robots; or smart concrete bridge spans designed to reduce crack formation? Reginald Hamilton, associate professor of engineering science and mechanics, has—and his research is changing the shape of things.



A close-up of SMA deformation.

"Conventional metals, such as steel, aluminum, and copper, typically pop back to their original shapes below deformations of 0.002 inches per 1 inch gage length," said Hamilton. "However, SMAs such as nickel-titanium (Ni-Ti) or copper-aluminum-nickel, can undergo 50-times this deformation and still recover their original shapes."

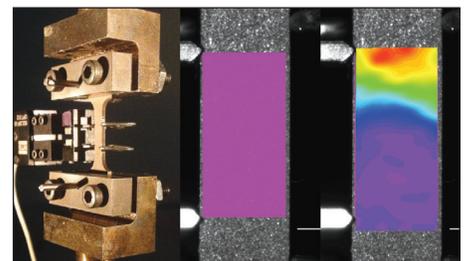
Also known as smart materials, SMAs display superelasticity and exhibit extraordinary response to mechanical, thermal, or magnetic stimuli. The materials undergo large deformations for gross shape changes, and upon heating or removing the external stimuli (i.e. mechanical load or magnetic field), the deformation is recovered and the materials "remember" their original shape and form. Consequently, SMAs can be integrated into robots as sensors, automobile fenders for energy dissipation, actuators, and self-adapting or self-healing structures.

"The advantages of biocompatible SMAs become clear when they are used in endoscopic devices that 'snake around' parts of the body," said Hamilton. "For example, stents can be crushed within a narrow tube until they are released into a blocked artery, where they expand and restore blood flow in a minimally invasive procedure."

The Hamilton Group is exploring additive manufacturing to fabricate new 3D designs of SMA structures. They begin by depositing pre-blended Ni and Ti powders on a substrate and melting them with a laser beam in computer-aided design patterns using state-of-the-art facilities in Penn State's Center for Innovative Materials Processing through Direct Digital Deposition. While these are bulk samples, their crystal structure can be controlled at the micro-scale

(microstructure), and the internal martensite, which is responsible for the shape change, may even be controlled at the nano-scale.

Deformation of bulk SMAs can be measured by shining a speckle interference pattern on the surface and plotting the martensitic transformation contours during the gross shape change, as shown in the image below. When the mechanical behavior is related to the microstructure and processing route, it becomes possible to enhance SMA lifetimes by, for example, retarding defect formation during cyclic deformation known as fatigue.



Speckle pattern on a 5x3 mm sample shows martensitic transformation contours when the specimen is elongated.

"SMAs are already used for dental braces, Stiquito (the six-legged hexapod robot), and springs; however, as we move towards the micro- and nano-scales, new realms of applications with new types of motion will open up," said Hamilton. "Smaller and lighter SMA-based devices are replacing electric motors, solenoids, and piezoelectric actuators, and they are appearing in toys and insulin pumps. SMAs have an exciting future—in next-generation robots, biosuits for astronauts, and even in missions to Mars...and beyond!"



## Message from Your Alumni Society Chair

I would like to first congratulate Dr. Todd, the first to be featured by ASM International in a new series that profiles leading materials scientists from around the world who happen to be female (*read the article here: <http://bit.ly/2gKixxa>*). I also want to recognize Ben Ross (B.S. E SC '06, M.S. E SC '07) as the 2016 ESM Early Career Recognition Award recipient. Read more about Ben's accomplishments in the article below.

Next, on behalf of the Alumni Society, I want to thank Rick Schutz for leading the ESM Alumni Society for the past two-plus years. Rick has been a very diligent and involved chairperson who provided inspired leadership to the society.

As Rick mentioned in his spring update, the Alumni Society is presently focused on initiating a mentoring

program (planned to launch in the fall of 2017) that will pair students and alumni with common interests and experiences to provide guidance to students in topics identified by the students. If you're interested in participating as a mentor, please contact Melissa Showalter in the ESM office.

The ESM Alumni Society is comprised of 15 to 20 alumni who have a broad range of backgrounds and careers. The society meets twice a year to see how we can best enrich the department and be of assistance to students. If you would like to be a part of the ESM Alumni Society, again, please contact Melissa Showalter in the ESM office.

Rich Smith ('73 E MCH)

## 2016 Early Career Recognition Award Winner



Benjamin Ross (B.S. E SC '06, M.S. E SC '07) is an entrepreneur, technologist, musician, and was this year's 2016 Early Career Recognition Award recipient. After receiving his Ph.D. at the University of California, Berkeley, and publishing more than 20 papers and patents, Ross founded

Diassess, a company developing rapid point-of-care DNA testing. He went on to lead development at Carrotmob ("vote with your money") and GoOverseas ("Yelp for programs abroad"), and is currently founder and CTO of POWr.io, a leading web plugin library. The ESM Early Career Recognition Award recognizes alumni who graduated in the past 10 years who have distinguished themselves at work and/or in their community.



## WE ARE...HIRING!

### Tenure-track Assistant Professors

The ESM department currently has openings for three new tenure-track assistant professors, though exceptional faculty at higher ranks may be considered.

Learn more at [www.esm.psu.edu/department/job-opportunities.aspx](http://www.esm.psu.edu/department/job-opportunities.aspx).

## Contact ESM

| Name              | Department                               | Phone        | Email                  |
|-------------------|--|--------------|------------------------|
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| Rich Smith        | Alumni Society Chair                     | 724-689-9310 | golions@windstream.net |
| Melissa Showalter | Alumni, Development, and Advancement     | 814-867-1569 | mus41@psu.edu          |
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