

Investing in the Future

ESM alum John “Jay” Falker knows the importance of having a diversified portfolio—but not the kind most people are familiar with—and he’s banking on the future of air and space travel.



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As the Early Stage Portfolio Executive at NASA Headquarters, Jay Falker ('96 E SC) leads research and early development in the Space Technology Mission Directorate (STMD), which focuses on innovative and cross-cutting technologies to improve future aerospace capabilities.

“Our job in STMD is to develop new technologies and concepts from many disciplines that help NASA do more in space but also lead to wider benefits on Earth,” Falker said.

With more than 400 projects in his portfolio, Falker assists researchers and engineers in areas such as robotics, instruments, and materials to determine if new ideas could work and appear better than current options.

“Our findings enable NASA to make strategic decisions about what to invest in next, so that years from now, we will have new capabilities that benefit multiple missions.”

Falker’s diverse education and experience prepared him well for his new role.

“Engineering science introduced me to many options, which steered me towards transportation,” said Falker. “My interest in complex systems involving human factors and policy issues then led me to air traffic management and opportunities to work on futuristic aerospace transportation.”

While earning a Ph.D. in aerospace engineering

and policy analysis at MIT, Falker learned how to “talk the language” with policy makers, lawyers, and business managers, opening the door for what he describes as “the biggest thing I ever did.”

In 2004, Falker was asked to lead the largest research and technology realignment (a \$2.2 billion portfolio) in NASA history to help NASA return humans to the Moon, earning him the Outstanding Leadership Medal, the highest leadership award NASA can give.

“It was an incredible thing to be a part of,” said Falker. “The odd mix I had of engineering, policy, and decision analysis turned out to be quite useful.”

Today, Falker is focused on pushing the boundaries of engineering science and science fiction to find out what could be possible, such as sending a submarine into a liquid methane lake on Saturn’s largest moon.

“There is a lot happening at the interface between engineering and other fields such as biology and even history that we’re learning from,” said Falker. “The conversation is getting broader and as mankind does more in space, we’re going to expand the sphere of human influence up and beyond. It makes me truly excited about the future!”



Photo credit: NASA/MSFC

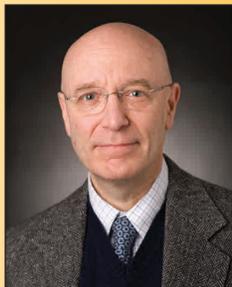
Message from the Chair



Fall 2015 got off to a great start with the arrival of 42 junior students and two new faculty members, Ibrahim Ozbolat and Huanyu (Larry) Cheng, both of whom are featured in this newsletter. Watch out for our spring edition and a highlight

on our third new faculty hire, Saptarshi Das.

Congratulations to Steven Schiff, director of the Center for Neural Engineering, who was awarded a \$4.1 million NIH Director's Pioneer Award to identify the root causes of the bacterial infection neonatal sepsis. Using new genomic approaches to DNA and RNA analysis of infants and their mothers in Uganda, Schiff aims to identify optimal antimicrobials to administer to newborns with sepsis.



Steven Schiff

This semester saw several staff transitions. We said fond farewells to ESM's undergraduate staff assistant, Kristin Fink, when she accepted a position with the Department of Defense in Baltimore. Shortly after, we welcomed Tammy Coval, who brought 14 years' experience from Penn State's mathematics department to ESM. Chris Spallino also joined us as our new communications strategist. Please send him all your news.



Tammy Coval



Chris Spallino

Hot off the press—IEEE has just notified us that both Tony Huang and Akhlesh Lakhtakia will be elected Fellows, effective January 1, 2016. Congratulations to both!

A very Happy Holiday Season and New Year to you from all in ESM!

Warm regards,

Judith A. Todd

Judith A. Todd

Faculty Spotlight

Melik C. Demirel Wins Inaugural Humanitarian Materials Award



On September 29, at Materials Day 2015, the Penn State Materials Research Institute (MRI) announced that Demirel was a winner of one of the first-ever MRI Humanitarian Materials Initiative awards, created to support ongoing research focused on providing long-term, sustainable solutions to problems in under-resourced regions of the world.

Out of 13 proposals submitted, three were selected for the awards. Demirel's proposal, titled "Thermal stabilization of vaccines for the developing world," aims to show how we can stabilize and preserve biologically active agents used in vaccines, focusing on the heat-stable rotavirus vaccine. Funding from the award will be applied to vaccine stabilization research and field testing.

Graduate Spotlight

Double Duty for Scott Tucker



Scott Tucker, ESM's first-ever candidate in the ESM/M.D./Ph.D. Joint Degree Program, passed his first round of medical exams earlier this year and began his ESM research in May. Focusing on structural biomechanics, his clinical career is motivating his translational research in orthopedics to directly impact patient care.

"My goal is to use my engineering training in mechanics to develop prosthetic devices that improve patient outcomes," said Tucker.

Tucker's research is exploring new computational designs for fixturing fractures that can be simulated and tested prior to patients undergoing surgery. Following completion of his Ph.D. in May 2018, Tucker will return to the Penn State College of Medicine to complete his remaining two years of medical school and then begin his residency at the Penn State Milton S. Hershey Medical Center.

Undergraduate Spotlight

Amazing Students Do Amazing Things

The generous support ESM students receive from benefactors does not go unnoticed, nor is it undervalued. The aid from scholarships helps lighten our students' financial burdens, enabling them to better concentrate on their studies and research, work towards making significant contributions to the world, and according to one student, "fulfill all of my dreams that would not be possible without the generosity I received."



ESM graduates, spring 2015

ESM students have the desire and dedication to lead the world in innovation. As one scholarship recipient stated, "Your support of young Penn State students has an impact that extends well beyond what you can see and is providing opportunities for amazing people to do amazing things."



2015 Golden Decade Reunion

Five Alumni Honored as Golden Decade Fellows

The annual ESM Golden Decade Reunion was held June 4-5, 2015, at the Penn Stater 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 '65, '70, '75, '85, '90, '95, '05, and 2015. Five individuals were honored as Golden Decade Fellows (50+ year alumni): James Beasom ('65), Glen Chatfield ('65), Glenn Schmehl ('65), Edmund Simon ('65), and James Sumpter ('65).

Friday's half-day program consisted of a state of the department address by Judith Todd, department head and P. B. Breneman Chair; a faculty seminar presentation by Assistant Professor Patrick Drew titled "What does blood flow tell us about neural activity in the brain?"; a Meet & Greet with ESM students; and a "Meet the Dean" luncheon.



James Beasom ('65 E SC), Golden Decade Fellow, and Richard P. McNitt, Professor Emeritus

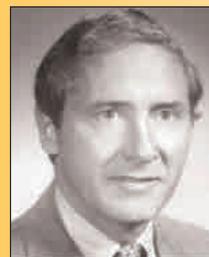


George Koch ('75 E MCH) and wife, Mary Koch

We look forward to seeing you at the 2016 Golden Decade Reunion, June 2-3, 2016. For more information or to R.S.V.P., visit www.esm.psu.edu/alumni/reunion.



In Memoriam: Mason Walsh, Jr.



Mason Walsh, Jr. ('57 CH E), 79, passed away on September 22, 2015, in Ligonier, PA.

Walsh, who grew up in State College, PA, graduated with honors from Penn State in chemical engineering and received his law degree from

Harvard University in 1960. In 2002, he endowed the P. B. Breneman Department Head Chair in honor of his grandfather, Paul (P. B.) Breneman, and his 30 years of service to the University. Judith Todd was the chair's first recipient in 2002.

Breneman graduated from Pennsylvania State College with a B.S. in civil engineering in 1894 and earned an M.S. in civil engineering in 1897. He later served as a professor of engineering mechanics and head of the department (then known as the Department of Engineering Mechanics and Materials of Construction) from 1908 until he retired in 1938 with the rank of professor emeritus.

The value of Walsh's generous endowment cannot be overstated. It has enabled the ESM department to grow our undergraduate and graduate programs and pioneer a strategic vision of interdisciplinary science and engineering far beyond our founder's wildest dreams.

ESM Recruitment Mixer Brings Out the Best

ESM held its annual Recruitment Mixer on September 16 in conjunction with Penn State's Fall Career Days. The evening event, held in the Earth and Engineering Sciences Building, was well attended by more than 70 students and 20 companies. Students interacted with a wide range of companies and secured interview sessions at Career Days for internships and co-op opportunities. Participating companies included BP, Advanced Cooling Technologies, Boeing, Pepsi, and Lehigh Hanson, among many others. If your company is interested in participating in the 2016 fall mixer, please contact Melissa Showalter at mus14@psu.edu or 814-867-1569.



Announcing ESM's One-Year Graduate Programs

Did you know the entire scientific and technological world can be your playground—a place where you can carry out research that spans more than one discipline? It can also be where you engender an entirely new area of scientific and technological research.

Led by our world-class faculty, our two, new one-year non-thesis graduate programs, Master of Engineering (M.Eng.) in Engineering Mechanics and Master of Science (M.S.) in Engineering at the Nano-scale, provide opportunities for individuals with bachelor's degrees in engineering, science, mathematics, and related fields to expand their knowledge in mechanics and nanotechnology applications for electronics, transportation, sports, agriculture, pharmaceuticals, and medicine, among others.

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, resident, interdisciplinary programs. Learn more about each program at www.engr.psu.edu/gobeyond.

Please note: The Master of Science (M.S.) in Engineering at the Nano-scale is a proposed program and is subject to final approval by the Penn State Board of Trustees for a fall 2016 first-planned offering.



Faculty Honors/Awards



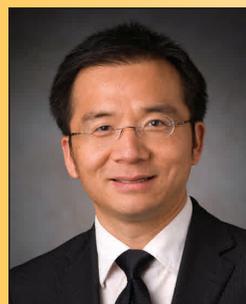
Cheng is Already Leaving His Mark, With an Even Brighter Future Ahead

Huanyu (Larry) Cheng, assistant professor, brought the new field of wearable electronics to ESM when he joined the faculty in August 2015. His highly interdisciplinary research involves collaboration with experimentalists and theorists in materials, mechanics, biology, and medicine.

After only two months, Cheng's accomplishments in health monitoring have already earned him two significant honors: (1), a 2015-2018 Early Career Development Professorship for proposing exceptional teaching and research initiatives; and (2), a Haythornthwaite Research Initiation Grant, awarded by the Applied Mechanics Division of the American Society of Mechanical Engineers.

Both awards provide financial resources that allow faculty to explore new ideas and jumpstart their teaching and research activities, accelerating their impact on our students. The Haythornthwaite Foundation Award specifically targets university faculty engaged in research in theoretical and applied mechanics who are at the beginning of their academic careers.

Keep an eye out for upcoming ESM stories featuring Cheng's research and success.



Tony Huang Awarded Huck Distinguished Chair

Tony Huang, professor of engineering science and mechanics, was selected by the Huck Institutes of the Life Sciences and the College of Engineering to fill a new endowed professorship—the Huck Distinguished Chair in Bioengineering Science and Mechanics. Effective fall 2015, the professorship provides \$30,000 in research funding for three years.

“Tony's interdisciplinary innovations integrate research across the engineering, life sciences, materials, and biomedical disciplines,” said Judith Todd, department head and P. B. Breneman Chair. “His acoustic tweezers and lab-on-a-chip inventions have the potential to revolutionize personalized medicine across a broad spectrum of human diseases.”

ESM Frontiers

The Future of Tissue Engineering and Organ Transplants

New faculty member Ibrahim Ozbolat sees a bigger picture when it comes to his research in 3D bioprinting of human tissues and artificial organs, and it could change many lives.



People might not think something as simple as a printer could save a life, but one day not too far

in the future, they may think differently due to the advances in 3D bioprinting of living tissues and organs made by Ibrahim Ozbolat.

“3D bioprinting has huge potential for manufacturing organs for transplantation,” said Ozbolat, associate professor, “but our goal is not to manufacture organs that are 100 percent the same as natural ones; it’s to make something close enough that functions sufficiently to restore the functionality of a failed or damaged organ.”

“A human organ is one of the most complicated, complex machines you will ever see,” noted Ozbolat. “We can easily print very small tissue models, but fabricating larger, more complex ones, with a greater number of cell types, is much more challenging.”

The biggest obstacle to printing a full organ is vascularization—with different tissue types having different sensitivities to vascular networks and oxygenation. Even if cells are successfully bioprinted, without an effective network of blood vessels to deliver essential nutrients and oxygen to them, they will die.

One method of bioprinting involves using a modified ink jet printer

to deposit bio “inks” containing tissue-specific cells or individual materials required to build the organ tissue, layer by layer. The ink jet printer is extremely precise and can facilitate vascular construct, but it is not capable of integrating vascular networks with tissue.

Ozbolat saw this as an opportunity to advance the bioprinting field with the design of his multi-arm bioprinter. This unique machine allows simultaneous printing of vascular networks integrated with cellular aggregates through controlled positioning of the printer’s individual arms, resulting in an increased rate of cellular survival and reduction in manufacturing time versus an ink jet printer.

“The multi-arm printer gave us greater flexibility to deposit biodegradable hydrogels containing all the necessary ingredients for cell growth and allowed cells to develop their own extracellular matrix,” said Ozbolat. “The cells were able to more rapidly self-organize, proliferate, and form functional tissues.”

“What normally took a few days to develop, only took 12 hours,” he noted. “This scaffold-free approach also provided sufficient structural and mechanical integrity for both the cells and the more complex vascular networks that were integrated with them.”

The success of Ozbolat’s printer has opened the door for his research team to explore new

applications of 3D-bioprinted organs to the field of medicine. One example is printing insulin-producing pancreatic tissue that can regulate blood sugar. According to Ozbolat, such an achievement could dramatically change patients’ lives and how doctors treat type 1 diabetes, and it could significantly impact how pharmaceutical companies conduct drug testing.

The 3D bioprinting space has rapidly progressed over the last five years and will continue to push boundaries previously thought impossible. Ozbolat is already exploring the idea of manufacturing electrogenic organs that could discharge electricity and generate their own power as “biological batteries” to operate pacemakers or prosthetic devices.

“Eventually, we’ll make something that will extend people’s lives,” he said. “And that is why I’m passionately dedicated to this work.”



Ibrahim Ozbolat's multi-arm 3D bioprinter

Organ printing image in header: Bioprinter concept design by Christopher Barnatt/ExplainingTheFuture.com



Message from Your Alumni Society Chair

It's not surprising that ESM alumni and students continue to be recognized respectively for contributions in their fields and for the depth and breadth of their studies. As you've read in this issue, Jay Falker has been recognized for making major contributions to NASA and its ever-growing portfolio of technology programs aimed at changing the future of aerospace capabilities. Our faculty continue to garner high-profile honors and awards, showing that the ESM department is made up of the highest caliber researchers, educators, and engineers. On the students' side, the ESM recruitment mixer held in the Earth and Engineering Sciences Building was a great success and met with positive reviews from the attending companies—impressed by the quality of ESM students, one company representative asked her HR staff to add ESM majors to the list of students to interview on campus. ESM has made tremendous strides in 2015, and I can't wait to see what 2016 will bring.

I encourage ESM alumni to come back to visit the University. There have been so many incredible changes and additions to the campus, both physically and academically. The rest of the University has finally

embraced our ESM concept of multi-disciplinary focus. One significant example is the College of Engineering and Smeal College of Business teaming up to offer a business curriculum for engineering students. And the University is encouraging all students to think about minoring in entrepreneurship. In addition, State College continues to grow stronger economically and culturally. This is a great place! Students have expressed a strong interest in hearing from ESM alumni working in the bioengineering field ... so come on back to campus and help our students, and see the amazing things they are accomplishing.

The Engineering Science and Mechanics Alumni Society would like to welcome our newest members, Patrick Mather ('89 E SC, '90 M.S. E MCH) and Kyle Sinding ('14 E SC, '14 M E, '15 M.S. ESMCH).

As a reminder, the ESM department is currently accepting early career award nominations, so let them know if you have someone in mind or want to nominate yourself.

Rick Schutz ('72 E SC)

2015 Early Career Recognition Award Winners

Mukul Dixit ('07 E SC, '08 M.S. E SC, '12 M.Eng. SYSEN), lead engineer at Harris Corporation, and Shawn Keebaugh ('03 E SC, '08 Ph.D. ESMCH), semiconductor device engineer at Northrop Grumman, were this year's Early Career Recognition Award recipients. Dixit and Keebaugh were recognized for their exceptional achievements and success early in their careers and for their potential to make a significant impact in their work and communities.



Mukul Dixit and Rick Schutz



Shawn Keebaugh and Rick Schutz

Seeking Nominations...

The ESM Alumni Society is seeking nominations for the 2016 Early Career Recognition Award. Please submit nominations, including self-nominations, at esm.psu.edu/alumni/honorees by May 30, 2016.

Contact ESM

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