Ray W. Herrick Laboratories

Herrick Newsletter

Volume 31 Number 1
Summer 2018

Herrick Laboratories PURDUE UNIVERSITY

Inside This Issue

Upcoming Events:

July 8, 2018 Short Courses

July 9-12, 2018 Compressor, Refrigeration & Building Conferences

*Herrick Laboratories Building, 1912***
From the J.C. Allen Collection, courtesy of Purdue University Libraries, Archives & Special Collections

New Ray W. Herrick Laboratories Building, opened November 2013

2018 Purdue Conferences, July 9 - 12

In 1972, a group of Purdue University professors saw the need for a research conference on compressors and started the International Compressor Engineering Conference. In 1986, the refrigeration conference was added, and in 2002 research on air conditioning became part of this conference. 2010 brought another addition to these research conferences with the High Performance Buildings Conference. July 9 - 12, 2018 will mark the 24th Compressor Engineering Conference, the 17th Refrigeration and Air Conditioning Conference; and the 5th High Performance Buildings Conference. Plan now to join us in July!

The conferences are hosted by the Purdue Center for High Performance Buildings at the Ray W. Herrick Laboratories. This is an excellent opportunity for practitioners and researchers in industry, government, consulting offices, laboratories and universitites to reach an audience of over 800 participants from over 30 countries. In today's economy, it is important to maintain your professional contacts and to keep current on the latest research. The conferences technical sessions run simultaneously enabling attendees to attend sessions of interest from any of the three conferences. Conference registration includes online access to the conference schedule, presented papers and all social networking events. Tours of the research facilities will also be available.

The Keynote and Plenary speakers will address current, world-wide issues of interest facing our society today. **Andy Pearson** (Group Managing Director, Star Refrigeration, Ltd.) will deliver the keynote address on Monday speaking on "Innovation in Refrigeration and Air-Conditioning".

The Plenary speakers for Tuesday through Thursday are:

Ed Arens (Director, Center for the Built Environment, University of California, Berkeley) will discuss personal comfort research being done at the Center;

Jack Elson (Retiree, Emerson Climate Technologies) will speak on the progression of the reciprocating compressor technology; and

Reinhard Radermacher (Co-Founder of the Center for Environmental Energy Engineering) will give a presentation titled "Future Perspectives of AC/R/HP" that will explore opportunities for energy efficiency in buildings in general and HVAC&R in particular.

The Short Courses and Workshop will be held on July 8. The topics to be discussed are: Compressor 103: Generalized Simulation Framework for Positive Displacement Compressors and Expanders; The Transition to Flammable Refrigerants; and 2018 Intelligent Building Operations Workshop.

More information on the 2018 conferences can be found at engineering.purdue.edu/herrickconf.

2018 Purdue Conferences
Compressor Engineering
Refrigeration and Air Conditioning
High Performance Buildings

2018 Purdue Conferences (continued)

ORGANIZING COMMITTEE

General Chair ..... Eckhard A. Groll
Refrigeration and Air Conditioning Conference Chair ..... James E. Braun
Refrigeration and Air Conditioning Conference Co-Chair ..... Neera Jain
Compressor Conference Chair ..... Travis Horton
Compressor Conference Co-Chair ..... Davide Ziviani
High Performance Buildings Conference Chair ..... Thanos Tzempelikos
High Performance Buildings Conference Co-Chair ..... Brandon Boor

SHORT COURSES AND WORKSHOP

Compressor 103: Generalized Simulation Framework for Positive Displacement Compressors and Expanders

In this third edition of the compressor modeling short course, a generalized simulation framework for the modeling of positive displacement compressors and expanders will be presented. Such a model is very useful during the design and optimization phases and helps identify major losses. A comprehensive overview on the state-of-art of mechanistic models of positive displacement machines will be given. Due to the fact that all the mechanistic models present a similar structure, a generalized modeling platform has been developed and validated at the Ray W. Herrick Laboratories. The generalized platform will be used to demonstrate the flexibility of such modeling tool on dealing with different numerical challenges associated with leakage flows, friction losses, thermal network, and control volumes among others. Reciprocating, rolling piston and scroll compressors will be used as main examples. In particular, the theoretical presentations will be integrated with practical examples in the Python programming language. The goal of the short course is to give a solid background on positive displacement modeling that can be further employed and developed by researchers.

Organizers: Davide Ziviani (Purdue University), Orkan Kurtulus (Purdue University)

The Transition to Flammable Refrigerants

CFC refrigerants were developed in 1928 as nonflammable, nontoxic alternatives to the common chemicals in use at that time. These chemicals allowed refrigeration and air conditioning equipment to be placed in all forms of human housing, workplaces, and transportation. While toxicity was perhaps the more critical factor, nonflammable refrigerants could be used with fewer restrictions than was required for flammable alternatives. The need for refrigerants with more benign environmental impacts has made mildly flammable refrigerants a likely option for widespread adoption in the near term. The introduction of flammable gases will require substantial changes in many common manufacturing, testing, installing, and servicing aspects of HVAC&R equipment to comply with current and future safety codes.

The short course speakers will discuss the basics of fire dynamics in refrigerants, flammability tests and standards, and safety code requirements for the use of flammable gases in various building applications. Updates to international equipment standards and recent research results that address HVAC components for flammable refrigerants will also be presented. Finally, changes in equipment installation, service, and refrigerant handling will be covered, along with changes in employee training that will likely be required for those involved in these areas.

Recognized experts in refrigerant flammability, pertinent safety codes, and flammable refrigerant applications will share their knowledge and experiences in discussing changes that will be required for the next generation of refrigerants.

*Electronic presentation files will be provided to all participants. Those attending the short course should bring a laptop computer to follow along and take notes.

Organizers: Bill Murphy (University of Kentucky, retiree)

2018 Intelligent Building Operations Workshop

This will be the fourth in a series of workshops that bring together researchers and developers of intelligent building features and systems. The goal is to gain a better understanding of the state of intelligent building technologies and to identify existing gaps that should be addressed in future research and development. The one-day workshop will feature selected presentations of case studies that highlight recent developments and demonstrations of advanced sensing, control and diagnostic technologies, occupant interactions, and grid interactions. The format will encourage an open discussion to address what is necessary to move from research to widespread adoption of intelligent building technologies. The marketplace has been slow to offer these high-level features because of high implementation costs associated with site-specific solutions. This workshop will focus on technology solutions that can enable scalable and cost-effective intelligent building operations. In addition to the workshop, several technical sessions will be held during the International High Performance Buildings Conference that address technological developments critical for achieving scalable and cost effective intelligent building operations. Presentations will be supplemented with papers that are part of the proceedings of the conference. A single registration fee will cover participation in both the IBO Workshop and the HPB Conference. In addition, participants will be able attend any of the technical sessions associated with the Purdue International Compressor and Refrigeration and Air Conditioning Conferences, which are held concurrently.

Organizers: Jim Braun (Purdue University), Gregor Henze (University of Colorado), Panagiota Karava (Purdue University), and Neera Jain (Purdue University)

2018 Purdue Conferences - (continued)

2018 Purdue Conferences

24rd Compressor Engineering
17th Refrigeration and Air Conditioning
5th High Performance Buildings

Hosted by
Purdue Center for High Performance Buildings
Ray W. Herrick Laboratories

SHORT COURSES: JULY 8, 2018 • CONFERENCE: JULY 9-12, 2018

Stewart Center, Purdue University, West Lafayette, Indiana, USA

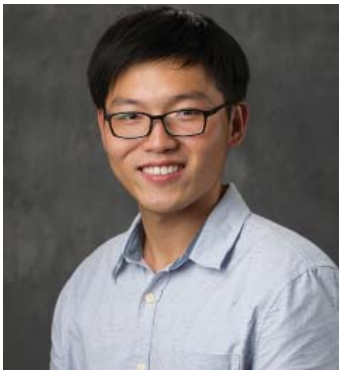
Carrier turn to the experts
EMERSON. Climate Technologies
Johnson Controls
Rheem
embraco
Parker
Tecumseh

ENGINEERING.PURDUE.EDU/HERRICKCONF

Thermoacoustics Discovered in Solids - Profs. Fabio Semperlotti, Carlo Scalo, & student Haitian Hao

(Adapted from an article by Purdue News Service)

Fabio Semperlotti



PhD student, Haitian Hao

A solid can serve as a medium for heat and sound wave interactions just like a fluid does for thermoacoustic engines and refrigerators – resulting in leak-free machines that can stay operating longer.

Leaky systems have limited how engineers design thermoacoustic devices that rely on the interplay between temperature oscillations and sound waves. Researchers at Purdue and the University of Notre Dame have demonstrated for the first time that thermoacoustics could theoretically occur in solids as well as fluids, recently presenting their findings at the 175th Meeting of the Acoustical Society of America. "Although still in its infancy, this technology could be particularly effective in harsh environments, such as outer space, where strong temperature variations are freely available and when system failures would endanger the overall mission," said **Fabio Semperlotti**, Purdue assistant professor of mechanical engineering, who conducts his research at Herrick Laboratories.

Thermoacoustics has been an established and well-studied phenomenon in fluids – whether as a gas or liquid – for centuries. "Applying heat to a fluid enclosed in a duct or cavity will cause the spontaneous generation of sound waves propagating in the fluid itself," said Carlo Scalo, an assistant professor of mechanical engineering at Purdue. "This results in so-called singing pipes, or thermoacoustics machines."

While fluids have been historically used for these systems, the extra step of building something to contain the fluids and prevent leaks is cumbersome. This led the researchers to consider solids as a replacement. "Properties of solids are more controllable, which could make them potentially better suited to these applications than fluids. We needed to first verify that this phenomenon could theoretically exist in solid media," said Haitian Hao, Purdue graduate research assistant in mechanical engineering.

Thermoacoustics enables either waste heat or mechanical vibrations to be converted into other useful forms of energy. For refrigerators, sound waves generate a temperature gradient of hot and cold. The vibrating motion makes cold areas colder and hot areas hotter. Engines use an opposite process: a temperature gradient provided by waste heat leads to mechanical vibrations. Solid state thermoacoustics initially seemed unlikely, since solids are somewhat more "stable" than fluids and tend to dissipate mechanical energy more readily, making it harder for heat to generate sound waves.

The researchers developed a theoretical model demonstrating that a thin metal rod can exhibit self-sustained mechanical vibrations if a temperature gradient is periodically applied to segments of the rod. This balanced unwanted mechanical energy dissipation and showed that, like fluids, solids contract when they cool down and expand when they heat up. If the solid contracts less when cooled and expands more when heated, the resulting motion will increase over time.

Solids can also be engineered to achieve the needed properties for achieving high thermoacoustics performance. "Fluids do not allow us to do this," Fabio said. Extreme temperature differences in space would be perfect for generating mechanical vibrations that are then converted to electrical energy on spacecraft. "A solid state device would use the sun as its heat source and radiation towards deep space as its cold source," Fabio said. "These systems could operate indefinitely, given that they do not have any part in motion or fluid that could leak out."

Researchers still need to complete an experimental setup to validate this design idea and better understand the thermoacoustics of solids as discovered through mathematical calculations and modeling. "Possible applications and performance of these devices are still in the realm of pure speculation at this point," Fabio said. "But the phenomenon exists and it has the potential to open some remarkable directions for the design of thermoacoustic devices."

Fabio Semperlotti foined Herrick Labs in 2015. See the Winter 2015 newsletter for more information on Fabio.

Origami Folds of Insect Wing Can Help Improve Machine Functions - Prof. Andres Arrieta

(Adapted from an article by Purdue News Service)

Andres Arrieta

The way that an earwig insect folds its wings could be applied to how engineers preprogram technology to perform certain tasks, according to research published on March 23 in the journal Science.

The earwig insect has more folds in its wings than any other organism in the animal kingdom but uses minimal energy to move. Through simulations and creating a 4-D replica of these folds, researchers from ETH Zürich in Switzerland and Purdue University have likened the wing to self-folding origami that could inform how to make machines be more adaptable and responsive with less energy used.

"The theory of origami assumes that you have 2-D, unstretchable materials," said **Andres Arrieta**, Purdue assistant professor of mechanical engineering, whose Programmable Structures Lab contributed to the study. "But imagine that you have a piece of paper and you try to stretch it, and you store some energy there. That stretching creates bistabilities."

Like conventional origami, the folds of an earwig's wing enable it to change shape. The earwig's origami design, however is far more complex; trying to stretch at folds would break paper, whereas stretching is central to the earwig's ability to self-fold and lock into specific geometries.

"It's like having an arm-wrestling contest. Each arm is pushing in a different direction, and then you reach some sort of equilibrium," Andres said. "For an earwig's wing, the crease has been stretched, but it is also constrained to lie in a particular geometry."

This simultaneous stretching and tension at a crease line led the researchers to coin this behavior as "spring" origami as opposed to how paper-like materials fold. This spring either extends or rotates at a crease by design as determined by the distribution of the protein resilin. The resulting bistability, or the ability to attain two stable shapes, means that the wing can unfold to fly or fold to crawl into the earwig's underground habitat.

"Bistability not only allows this pattern to have two stable configurations – one fully folded and one fully deployed – but it also allows each of these stable states to sustain loads," Andres said, meaning that no extra energy is required for each state to lock and hold the earwig's weight during flight, or to maintain the wing tuck when walking.

The ability of an earwig's wing to quickly fold into shapes automatically and lock into these conformations without the need of an actuator, or "hand" as with paper origami, could be preprogrammed into the designs of robots, packaging, spacecraft and biomedical devices. Watch a Purdue YouTube video demonstrating these concepts at: https://www.youtube.com/watch?v=xV_hqxls-tI.

"This means that we could get a robot gripper to lift something and hold it without any extra energy, or enable the robot to conform to the shape of whatever it's interacting with while still being able to hold that object," Andres said.

The researchers also envision self-folding tents that don't require assembly and space satellite sails that hold specific shapes. Andres' group at the Herrick Labs is working on the designs of stents that could extend, conform and lock into the shapes of arteries more compatibly.

"Bistable origami can be made out of any material as long as you pre-stress it," Andres said.

This study was a collaborative effort between Andres Arrieta's group at the Herrick Labs at Purdue and lead author Jakob Faber and André Studart, researchers of complex materials within the department of materials at ETH Zürich. Faber spent three months at Purdue during the development of this work.

Andres Arrieta joined Herrick Labs in 2015. See the Winter 2015 newsletter for more information on Andres.

Product Packaging That Can Power Itself
Adapted from an Oct. 19, 2017 news release article from Clemson University

James Gibert

Gregory Batt, an assistant professor in the food, nutrition and packaging sciences department and director of the Clemson Transport Package Testing Laboratory, and **James Gibert**, a Clemson alumnus and asistant professor at the School of Mechanical Engineering at Purdue University, have received a $500,000 grant from the National Science Foundation to study triboelectric generators to understand the mechanisms behind contact electrification, the basis of triboelectric devices. James joined the Herrick Labs in 2015. See the Winter 2015 newsletter for more information on James.

Triboelectric energy harvesters convert mechanical energy to electrical energy, which is collected and used to charge rechargeable energy cells to power small electronic devices.

The work will provide the foundation for technology for smart packaging and powering sensors to monitor products while they are transported. It focuses on developing smart packages that can harvest their own power.

"The packaging industry is transforming," Gregory said. "The demand for and application of smart packaging devices used during the transport and storage of products continues to increase. Most of these devices require power. Development of an energy harvesting device that can harvest power from forces naturally occurring in the distribution environment while possibly mitigating those forces experienced by the product just makes sense."

"Smart" or "intelligent" packaging solutions include printed electronics, smart labels capable of illumination, time-temperature indicators and Radio-Frequency Identification (RFID) tags used for tracking and quick package identification.

"We will build on our previous work with modeling the vibration response of complex foam materials so that we can determine how to create a means to reduce the vibration transmitted to products while still generating adequate power," Gregory said. "Triboelectric devices have received little study in published research, making for an ideal opportunity for impactful work."

Researchers have spent the last decades designing mechanisms that offer innovative, flexible and cost-effective means to replace or augment batteries and power devices by converting mechanical motion into electricity, James said.

"This (study) has far-reaching implications in powering devices in the hyper-connected world known as the 'internet of things,'" James said. "Here you will have devices that communicate with each other autonomously and will be able to sense both their environment as well as detect if they are operating properly."

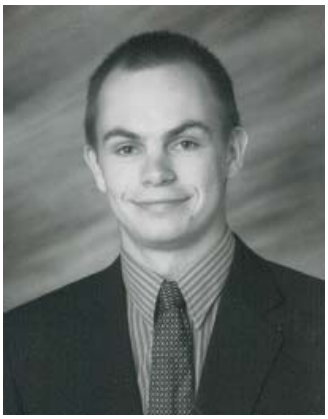
The study also focuses on creating economical packaging designs that can protect instruments from potential hazards.

"Sensors and devices used in smart packaging need to be self-sustaining as it will be difficult to change the power source during transportation," James said. "Triboelectricity offers a way to directly charge or power these devices."

James became interested in the research while studying at Clemson. He earned all of his degrees from Clemson: a bachelor's degree in mechanical engineering in 2002, a master's degree in mechanical engineering in 2004 and a doctorate in mechanical engineering in 2009.

"My Clemson education is invaluable to my duties as a teacher and researcher," he said. "My classes were rigorous in both undergraduate and graduate school. In addition, the engineering program, and Clemson in general, always stressed personal integrity and honesty when doing your work. I learned from my teachers and advisers how to tackle a problem, to think critically and to check my work."

Alumni Reflections - Ian Bell, Ph.D. 2011



Ian Bell - 2011

Though I received my Ph.D. in 2011 (7 years ago already ?!) from Herrick Labs under the esteemed team of Eckhard Groll, Jim Braun, Travis Horton, and Galen King, Herrick has never been far from my thoughts. I have been lucky enough to stay in a field of work that is quite closely linked with the work that I did at Herrick; in my day job at the National Institute of Standards and Technology (NIST) I develop empirical thermodynamic models for pure fluids and mixtures that are used in the industry-standard software REFPROP. Let's take a stroll back down memory lane...

After many very late nights slaving away to finish my degree (I'm sure other alumni can relate), I decided that a break was mandatory. You see, I did a direct Ph.D. program, and when I did the math, I realized that when I had finished my degree that I had been in a school of some sort for 21 years straight.

So I packed my bags and decided to see the world. In 11 months of traveling the world, I visited 4 continents, 14 countries, and had some of the most memorable experiences of my life; I'll never forget it. I would recommend this sort of adventure without reservation; it gives you a real appreciation for so many things that we take granted. For instance, how amazing it is that you can drink the water that comes out of your faucet at home; for many people, and in many places, it is unthinkable to drink the water from their own water pipes.

The next stop was a two year stint as a postdoc in the lab of Vincent Lemort in the University of Liège in Belgium. It was here that I continued the development of a number of open-source engineering software tools that I had begun while I was at Herrick. One of the tools (PDSim), is a flexible compressor simulation tool and underlies the compressor and expander simulation tools that are currently being developed at Herrick.

The other significant piece of work that I developed while in Liège is the thermophysical property software library CoolProp. CoolProp is the most advanced open-source thermophysical property library available today. It can trace its origins to the need to have an equation of state for carbon dioxide in my first compressor simulation code at Herrick. CoolProp has since grown to have a thriving user community, and the paper about CoolProp will likely eclipse 500 citations this year.

From my work on CoolProp, I came to the attention of Eric Lemmon, one of the head honchos of the thermophysical properties modeling world in the USA. He asked me whether I had given any thought to the possibility of a postdoc at NIST, and I had to admit to him that I had dreamed of a job at NIST and to be able to live in Boulder, Colorado. As it happens, I was able to get a postdoc at NIST and have been there ever since.

When I am not pecking away at my keyboard at work, I love to get out and explore Colorado's hills and mountains; I've now climbed three of their 14,000 foot summits and plan to tackle a few more this summer. I've also, out of necessity, become a rock climber; Boulder does this to people. I also dabble in ceramics which is a nice break from the everyday stresses of modern life.

But Herrick is never far away - I'll return for the conferences as long as I am able and look forward to reconnecting with the Herrick community once again.

Beautiful mountain range in New Zealand

Ian climbing Mt. Columbia in Colorado - elevation 14,073 feel

People News

Faculty Honors & News

Chuck Krousgrill

Prof. Charles "Chuck" Krousgrill was named as one of the 150th Anniversary Professors by The Office of the Provost to recognize his achievements in teaching at Purdue. Ten faculty were named as inaugural 150th Anniversary Professors to coincide with the upcoming 150th anniversary of Purdue. "The 150th Anniversary Professors have played a significant role in enhancing the lives of their students through their exceptional teaching, mentorship and innovation," says Jay Akridge, provost and executive vice president for academic affairs and diversity.

Chuck is a national and international leader in Mechanical Engineering and has received more than $2 million in Mechanical Engineering teaching development grants from the National Science Foundation, AT&T Foundation, GE Foundation, Amoco Foundation and Hewlett-Packard. He has earned seven H.L. Solbert Best Teaching Awards from the School of Mechanical Engineering, and three A.A. Potter Best Teacher Awards from the College of Engineering. He received the Charles B. Murphy Award for Outstanding Undergraduate Teaching and is a member of the Teaching Academy and Purdue"s Book of Great Teachers. He also has received the Special Boilermaker Award, the Helping Students Learn Award and the national Archie Hidgon Distinguished Educator Award, Mechanics Division, American Society of Engineering Education.

Anil Bajaj, the William E. and Florence E. Perry Head of Mechanical Engineering and Alpha P. Jamison Professor of Mechanical Engineering, noted Chuck's "extraordinary dedication to student learning, his ability to connect easily with students, and his innovative spirit in exploring emerging technologies."

The principal criteria for selection as a 150th Anniversary Professor included:

* Development or transformation of courses and/or curricula.

* Receipt of Purdue teaching awards at the department/ school, college and university level (i.e., Murphy Award or election to the Teaching Academy).

* History of outstanding teaching evaluations from faculty peers, students and/or alumni.

The 150th Anniversary Professors were selected by a committee of 13 senior faculty who are distinguished and named professors, winners of the Murphy Award, and members of the Teaching Academy. The inaugural 150th Anniversary Professorships will be funded by the Provost's Office until donors are found to endow these named professorships.

For the complete list of the 150th Anniversary Professors Class of 2018, go to: https://www.purdue.edu/provost/150/class-2018.html.

Eckhard Groll

Prof. Eckhard Groll was appointed to the Dean's Cabinet as the Associate Dean of Undergraduate and Graduate Education effective January 2018.

Prof. Eckhard Groll has received the Institute of Refrigeration J&E Hall Gold Medal.

The Institute, based in the United Kingdom, presented Eckhard the award in London this past February. Eckhard was selected based on his "most noteworthy contribution to the advancement of refrigeration."

His research focuses on thermal sciences as applied to HVAC&R systems and equipment.

The Institute of Refrigeration was founded in 1899 as the Cold Storage and Ice Association and was the first national society of mechanical refrigeration in the world. Today, it is an independent registered charity run for the public benefit and has a membership of more than 2,200.

Yan Chen

Prof. Qingyan (Yan) Chen has been named the James G. Dwyer Professor of Mechanical Engineering. Yan had been the Reilly Professor of Mechanical Engineering the last three years. His current research topics include indoor environment; aircraft cabin environment; and energy-efficient, healthy and sustainable building design and analysis. He has published two books and over 380 journal and conference papers, and has been invited to deliver more than140 lectures internationally.

People News - continued

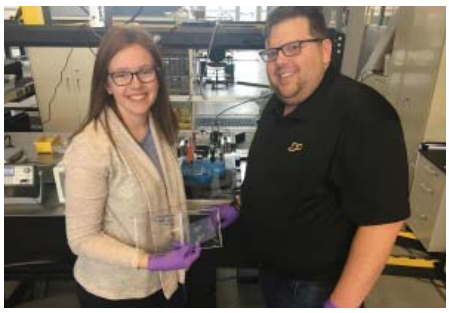
Jeff Rhoads

Prof. Jeff Rhoads has been awarded the Ruth and Joel Spira Award, as a Mechanical Engineering faculty who has inspired students and fostered excellence in product realization.

The award is named after Joel Spira, Founder of Lutron Electronics, who passed away in 2015. Joel received a B.S. in Physics from Purdue in 1948. He was a very good friend of Ray Cohen, the Labs' second director. In 1961, Joel started Lutron Electronics, that initially made light dimmers. Joel's insight into technology and manufacturing enabled him to build Lutron into a dominant force in the dimmer market. Throughout the years, Joel has given several generous contributions to the School of Mechanical Engineering and was the benefactor for the Ruth and Joel Spira Laboratory for Electromechanical Systems in ME.

Profs. Jeff Rhoads and George Chiu are two of the researchers who have developed a method to deposit tiny amounts of energetic materials (explosives, propellants, and pyrotechnics) using the same technology as an inkjet printer. This research, which combines Purdue expertise in both energetic materials and additive manufacturing, allows energetic materials to be deposited with unprecedented levels of precision and safety. The project, which has been published in the Journal of Applied Physics, has a team of 10 researchers and four faculty members from varying disciplines in Mechanical Engineering. **Jeff Rhoads** studies micro-electromechanical systems; **Geroge Chiu** is an expert in inkjet printing, and **Emre Gunduz** and **Steve Son** work at Zucrow Labs, studying energetic materials.

For full story, visit: https://engineering.purdue.edu/ME/News/inkjetprinted-thermite-combines-energetic-materials-and-additive-manufacturing



Jeff Rhoads and his student Allison Murray.
Allison was just awarded the 2018-19 Fontaine Fellowship.

George Chiu

Prof. George Chiu was appointed to the Engineering Leadership Team (ELT), which is composed of the Dean's Cabinet and the academic unit Heads.

Dave Cappelleri

Prof. Dave Cappelleri collaborated with Deaf Kids Code founder Shireen Hafeez on a do-it-yourself robot kit specifically for deaf and hard-of-hearing students, which uses light to control the robot. Deaf Kids Code is an organization that brings STEM-focused workshops to kids who are deaf or hard-of-hearing, at no cost. For more information on this organization, visit: http://deafkidscode.org.

To see the video of Dave and his students working with the Deaf Kids Code group, visit: https://www.facebook.com/PurdueME/videos/1836259683062615/.

Jun Chen

Prof. Jun Chen is part of a multidisciplinary team who received a national design grant from the Environmental Protection Agency for a sustainable system powered by solar and hydroenergy to store grains during the rainy season in rural Africa. This system can be implemented in domestic rural areas facing similar siutations during harvest season. Grain processing can be an environmentally taxing procedure and this new storage system can improve air quality by reducing the gas emissions typically released during conventional grain processing. Jun is the co-PI with Wenzhuo Wu, assistant professor of Industrial Engineering.

For the full story, visit: https://engineering.purdue.edu/IE/news/2018/wu-epa

People News (continued)

Graduations

Angre, Harshil (MSME 2018) Control of Urea Dosing for Urea SCR System in a Diesel-Powered Vehicle. Harshil took a position with Cummins Power Generation, Shoreview, MN.

Bahman, Ammar (PhD 2018) Analysis of Packaged Air Conditioning System for High Temperature Climates. Ammar took a faculty position in the Dept. of Mechanical Engineering in Kuwait University.

Heitkamp, Caleb (MSME 2018) Experimental Wave and Material Property Measurements for an Elastomer Binder and Particulate Composite Material. Caleb's employment is undecided at this time.

Hjortland, Andrew (PhD 2018) Automated Fault Detection, Diagnostics, Impact Evaluation, and Service Decision-Making for Direct Expansion Air Conditioners, Andy is working for Kysor Warren in Atlanta, GA.

Hollkamp, John (MSME 2017) Model-Order Reduction of Lumped Parameter Systems Via Fractional Calculus. John is staying at the Labs for his Ph.D. studies.

Kyle, Trevor (MSME 2018) Synthesis of Inhomogeneous Waves Using the Least-Squared Method. Trevor took a position with General Motors in Milford, MI.

Lavernia, Alejandro (MSME 2018) Micro-Scale Waste Heat Recovery from Stationary Internal Combustion Engines by Sub-Critical Organic Rankine Cycle Utilizing Scroll Machinery. Alejandro wil be starting a PhD program at UC Irvine.

Paripovic, Jelena (PhD 2018) Identification of the Low Frequency Dynamic Behavior of Surrogate Explosive Materials. Jelena took a position with Sandia National Laboratories in Albuquerque, NM.

Patil, Akash (MSME 2018) Development and Evaluation of Automated Virtual Refrigerant Charge Sensor Training Kit. Akash will be starting his PhD studies in the School of Civil Engineering.

Sadeghi, Seyed Amir (Ph.D. 2018) Visual Preferences and Human Interactions with Shading and Electric Lighting Systems. Amir's employment is unknown at this time.

Van Voorhis, Matthew (MSME 2017) Implementation of Aftertreatment Systsem to Enable Tailpipe Emissions Measurements of a Variable Valve Actuation Enabled Camless Diesel Engine. Matt took a position with Roush Industries in Livonia, MI.

Student Honors & Awards

Trevor Bird and **Katie Riley** each received a National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) Fellowship. The program recruits high-potential, early-career scientists and engineers and supports their graduate research training in science, technology, engineering and mathematics (STEM) fields. Trevor studies with Prof. Neera Jain and Katie is researching bio-inspired fast-morphing structures with Prof. Andres Arrieta.

Ting-Wei Liu, a Ph.D. student advised by Prof. Fabio Semperlotti, received the Best Paper award for his paper titled "Inducing and Tuning Edge-States in a Weak Topological Phononic Waveguide". This award was presented at SPIE's 25th International Symposium on Smart Structures and Materials + Nondestructive Evaluation held in March in Denver, CO. SPIE is the International Society for Optics and Photonics.

Weimin Thor, a MSME student advised by Prof. Stuart Bolton, was awarded the H. William Bottomley Research Scholarship. He received $1,000 for the Spring 2018 semester to help derfray the cost of lab expenses.

Abhilash Reddy Yedla, a MSME student advised by Prof. Peter Meckl, was one of seven graduate students awarded this year's "Estus H. and Vashti L. Magoon Award for Excellence in Teaching for 2018". The selection is made by both faculty and students to recognize those students who were exemplary in their work as teaching assistants or instructors.

Where Are They Now?

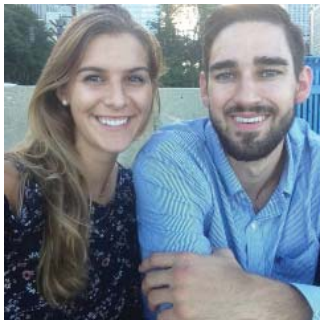
Heuk Jin (Bryan) Song, (Ph.D. 2001), recently accepted a position with NASA Goddard Space Flight Center as a Aerospace Engineer in the Mechanical Systems Analysis and Simulation Branch. He and his family will be relocating to the Washington DC area from Florida's NASA Kennedy Space Center.

Engagements

Yangfan Liu (Postdoc) and **Jie Ma** (current Ph.D. student) got engaged on April 27 during the annual Herrick Labs Spring picnic. It was a wonderful surprise for Jie and she said "Yes"! Their wedding date hasn't been set.

People News (continued)

Yutong (Tony) Xue (current Ph.D. student) and April Shao are engaged and will marry January 6th, 2019 in China. April is working on her Masters of Fine Arts in painting at the School of Art Institute of Chicago.



Caleb Heitkamp (MSME 2018) and Marisa DiBartolomeo got engaged at the Toledo Zoo Lights in December 2017. Marisa is also graduating this semester from the University of Toledo with a BSN degree. They will get married on May 25, 2019.

Births

Craig Bradshaw (Ph.D. 2012) and his wife Shawna welcomed a son on April 9th, 2018. John Robert weighed 8 lbs. 4 oz and 20.5" in length at birth. Craig is an Assistant Professor at Oklahoma State University in Stillwater, OK.

Yoon-Shik Shin (Ph.D. 2010 and his wife, Seungyeon Yoo welcomed their third child, a daughter named Stella Eunho. Stella was born May 23, 2017. She was welcomed home by her two older brothers, Hyunho, age 10 and Minho, age 8. Yoon-Shik is currently working for Bosch Company in Waltham, MA.

Herrick Awards Recipients

Allison Murray, a Ph.D. student co-advised by Jeff Rhoads and George Chiu, was awarded the William E. Fontaine Fellowship. This Fellowship was established in memory of Bill Fontaine, the founding Director of the Herrick Labs, to recognize a graduate student doing thesis-based research with entrepreneurial spirit. The fellow must have worked to improve the Herrick Laboratories community in the spirit of the first Director of the Laboratories. Allison began working in the labs as an undergraduate research assistant in 2014 and received her BSME in 2015. She works to utilize additive manufacturing as a tool to deposit unique material for system functionalization. Her research interests include dynamics, vibrations, sensor development, and additive manufacturing.

Trevor Bird, a Ph.D. student advised by Prof. Neera Jain, was awarded the Herrick Assistantship. This is an assistantship made possible by a Mechanical Engineering endowment established with funds from the Herrick family and descendants of Ray W. Herrick. The award covers the student's fees and a stipend for the student's degree status for up to one year. Trevor joined the labs last summer after receiving his BSME from Utah State University in 2017. His research focuses on the optimal control of combined heat and power systems to efficiently meet growing energy demand. Trevor's research interests include dynamic systems, optimal control, and distributed energy resources.

Past Herrick Labs Party Pictures

1969

1983

1989

Past Herrick Labs Party Pictures (continued)


2006


2007


2018

Donate to Herrick Labs

Donations to the Labs are always welcomed and appreciated. If you're interested in making a donation, below is some helpful information for you. For all of you who have contributed in the past: my sincere thanks. Your gifts help to create groundbreaking research and set a wonderful path to the future. Thank you for coming on board!

Be sure you specify your gift is for Herrick Labs. You are also welcome to support a specific professor's research, or support a few established funds:

* Herrick Laboratories Building Fund
* Herrick Laboratories General Operations
* Ray Cohen Excellence in Thermal Systems Fund
* William E. Fontaine Student Fellowship Fund

Giving by mail? Send your check to the address on back page of this newsletter, payable to the Purdue Research Foundation, with "Herrick Labs" and any additional designation on the memo line. Want to make an online gift? You can find details at the website: https://engineering.purdue.edu/ME/Giving/GivingGuide.

Specific questions about giving? (stock options, estate planning, deferred gifts, etc.) Purdue has philanthropy experts solely assigned to Mechanical Engineering who can help you! Contact the Director of Development, Scott Banfield at (765) 494-5629 or visit Mechanical Engineering's website at: https://engineering.purdue.edu/ME/Giving/index_html.

Below is a message from President Mitchell E. Daniels, Jr. concering the Ever True Campaign for Purdue University

Together, We Are Purdue!

Ever True: The Campaign for Purdue University is an invitation to the Purdue family to join together, through private giving and personal involvement, to boldly advance our University as a national and global leader that continues to move the world forward.

With a goal of $2.019 billion, Ever True is the largest fundraising effort in Purdue history. The campaign spans July 1, 2012, through June 30, 2019, concluding in the University's 150th anniversary year.

This campaign will propel the Purdue Moves initiatives—Affordability & Accessibility, STEM Leadership, World-Changing Research, and Transformative Education—and reinforce the University's overarching commitment to keep a rigorous college education within students' financial reach.

To learn more about this campaign, visit:
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News about You and Address Changes

We are always interested in hearing your news, like weddings, births, and job promotions, and we want to be kept up-to-date on current addresses. Please send notes to Donna Cackley or to the e-mail address below. Don't hesitate to let us know of other alums that have moved or changed jobs. Photos are always welcomed and encouraged.

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