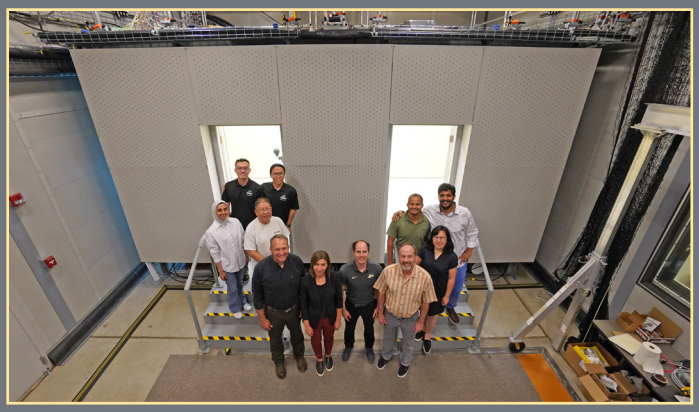
2023 ANNUAL REPORT

RAY W. HERRICK LABORATORIES

JULY 1, 2022 - JUNE 30, 2023



HOME OF **THE CENTER FOR HIGH PERFORMANCE BUILDINGS**

HERRICK LABS

2023 ANNUAL REPORT

PURDUE UNIVERSITY | Ray W. Herrick Laboratories

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NEW DIRECTOR AT HERRICK LABS

GREG SHAVER

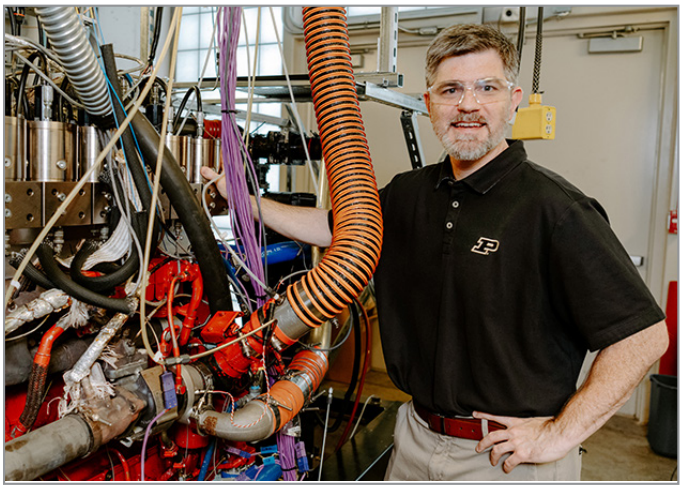
SHAVER

On October 24, 2022 Greg Shaver became the new Director of Herrick Labs. Greg is the sixth director of Herrick Labs since its founding in 1957.

Greg is a Professor of Mechanical Engineering, and has been an active member of the Ray W. Herrick Laboratories since he joined the faculty in 2006. He is a Fellow of SAE and ASME. He has previously served the School of Mechanical Engineering as Chair for the Systems Measurement and Control Academic Area and as the ME representative on the Engineering Faculty Affairs and Engineering Area Promotions Committees.

Greg has also served as the Engineering representative on the Provost's Advisory Committee for Diversity and Inclusion, and as a mentor for both the Susan Bulkeley Butler Center Coaching and Resource Network and Horizons Student Support Service programs. He has been named a University Faculty Scholar, College of Engineering Early Career Excellence in Research awardee, Purdue Innovator Hall of Fame inductee, Spira awardee for Fostering Excellence in Commercial or Defense Product Realization, College of Engineering Faculty Excellence awardee for Impact on Industry, and a Discovery in Mechanical Engineering awardee.

His research expertise is in system integration and control, most notably for commercial vehicles and their powertrains. He works extensively with the commercial vehicle industry. His team has made breakthroughs in diesel engine efficiency, helping motivate and justify new environmental regulations for commercial vehicles, hybrid electric powertrains, and in the partial automation of class-8 trucks, combines, and tractors. Greg has directed (and funded) the research efforts of more than 150+ current/former Purdue students (78 graduate, 80+ undergraduate). Of his 61 former graduate students (24 PhD, 37 MSME) one-fourth are women, more than half are now working at industry partner companies, and two are tenure-track faculty (1 assistant, 1 associate). His research is currently funded by DOE, Cummins, Eaton, John Deere, Allison, and ONR.

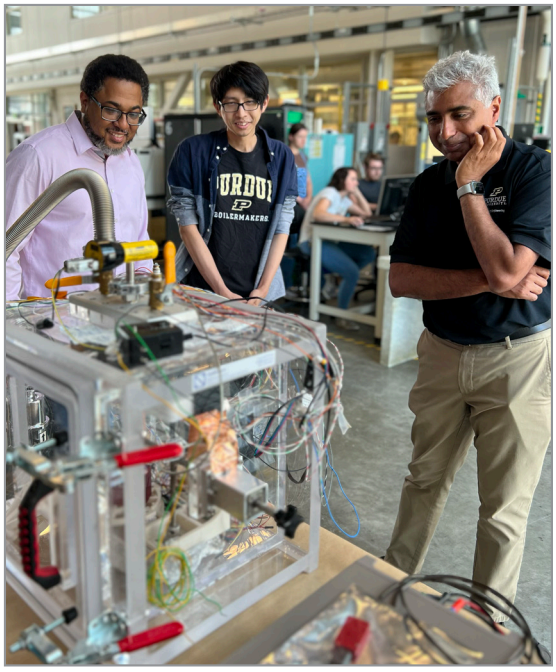


RAY W. HERRICK LABORATORIES
AT A GLANCE

The Ray W. Herrick Laboratories turns 65 years old in 2023. We are part of the School of Mechanical Engineering. The 38 Mechanical Engineering faculty and Architectural Engineering faculty who do research here collaborate on interdisciplinary research projects with faculty in the other Schools of Engineering and also with faculty in the College of Science, College of Health and Human Sciences, and the Purdue Polytechnic Institute. There are five main technical areas of research with some overarching themes related to energy utilization and efficiency, reduction of pollutants in the environment, quality of life, and sustainability and safety.

THE MAIN TECHNICAL AREAS ARE:

- High Performance Buildings, Thermal Systems, and Air Quality
- Noise and Vibration Control, which includes research on Acoustics, Dynamics, and Materials
- Electromechanical Systems & Advanced Engines: Controls, Signal Processing, Sensing, Estimation, Diagnostics, and Prognostics
- Perception-Based Engineering: Modeling of Human Response for Machine and System Optimization
- Manufacturing and Materials



The educational experience at Herrick combines the traditional training of aspiring researchers with exposure to industrial, governmental, and societal needs. Nearly 900 Masters and Ph.D. candidates have graduated from the Ray W. Herrick Laboratories.

Technology transfer to industry partners and disseminating through peer-reviewed publications, conferences, and short courses is an integral part of a majority of the research programs at Herrick Labs. The researchers are also widely published across the spectrum of publications from academic journals to the popular press.

MISSION

An institution dedicated to graduate education through engineering research with an emphasis on technology transfer.

VISION

To overcome the barriers between knowledge creation, transfer, and utilization for the advancement of society.

GOALS

1. Grow educational outreach activities, including fundamental, applied, and experimental short courses;
2. Build on research excellence in the following research areas: Noise and vibration control, integrated thermal and power systems, and the built environment;
3. Provide the educational environment of the labs so that its graduate students are multi-disciplinary engineers who rate as the top engineering graduates in the country;
4. Recognize and promote the value of Herrick through effective brand management (internally and externally);
5. Efficiently use our facilities;
6. Continue recruiting top faculty, grad students, and staff to ensure long term stability and growth. Maintain world-class facilities.

FY 2022 - FY2023 HIGHLIGHTS

RESEARCH - FISCAL YEAR	FY2022	FY2023
Research Expenditures	$13,042,648	$ 14,485,193

STUDENTS		
Graduate Student Researchers	173	185
MS	66	64
Ph.D.	107	121
Undergraduate Student Researchers	100	77
Post-Doctoral Researchers	13	11

STUDENTS GRADUATED		
MS	11	12
Ph.D. / Post Doc	3	7

VISITING RESEARCHERS		
Visiting Research Assistants	5	13

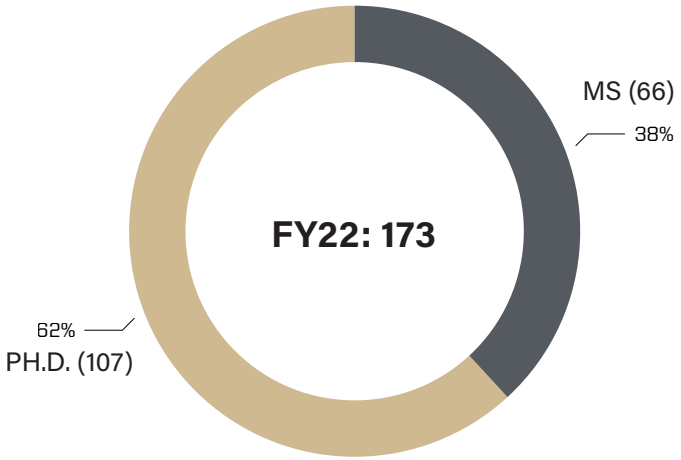
PURDUE DAY OF GIVING

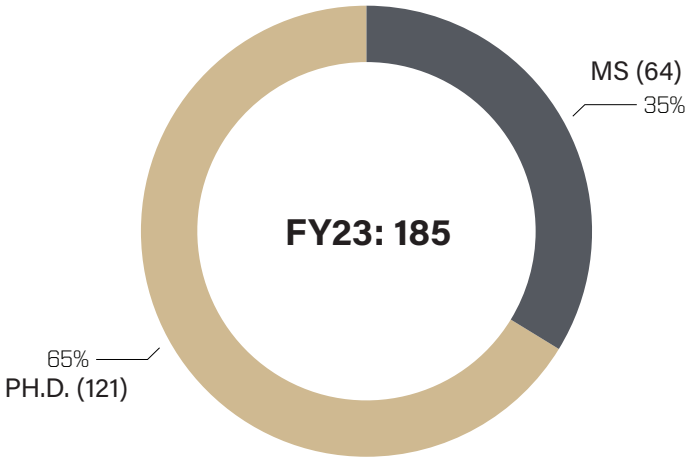
Thanks to the incredible generosity of Purdue alumni, faculty, staff, retirees, students, parents, and friends, the University is positioned to help our students pursue their goals like never before. During the 2023 Day of Giving the University raised a record $110.8M from almost 28,000 gifts!

HERRICK PROGRAMS & DEMOGRAPHICS

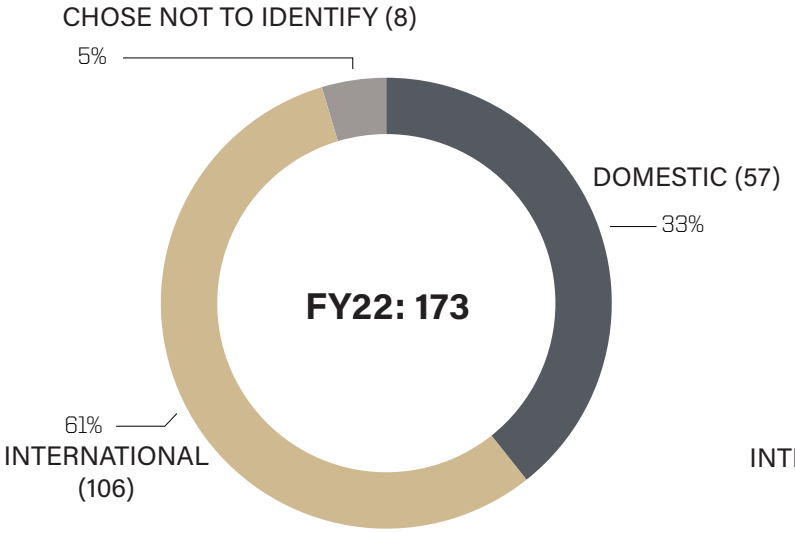
The primary educational mission at Herrick is thesis-based graduate programs and studies. We believe that the experiential learning, the open-ended, and integrative nature of thesis-based research is an outstanding preparation for both academic and industrial careers. To complement the student/advisor relationship, Herrick offers a learning community to the student. This community includes an outstanding cohort of graduate students, as well as a staff prepared to support and teach. In many cases, the student's research is sponsored. Sponsor representatives also participate in educational activities with the student. There are also opportunities for students to do internships in industry or government laboratories. In total, Herrick provides an outstanding educational opportunity for our graduate students.

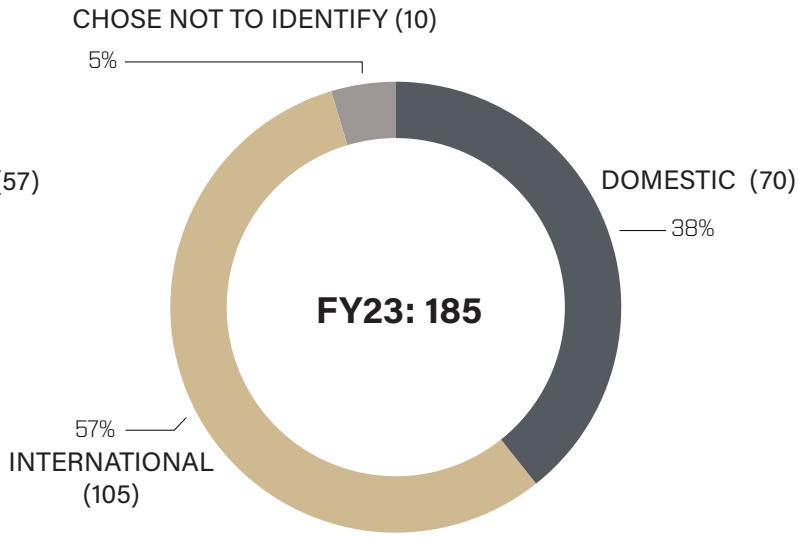
MASTERS & PH.D. STUDENTS





DOMESTIC & INTERNATIONAL





HERRICK SPONSORS

TOP 5 FEDERAL SPONSORS

2023

2022

TOP 5 INDUSTRIAL SPONSORS

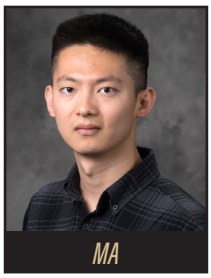
2023

2022

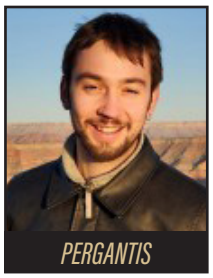
In FY 2022 and 2023, 26% and 28%, of the research funds came from industry partners. The top 5 industrial sponsors are shown above.

HERRICK STUDENT AWARDS & SUCCESSES

Jiacheng Ma, Yidan Cui, and Elias Pergantis all received a 2023-2024 American Society of Heating, Refrigeration and Air-Conditioning (ASHRAE) Grant-in-Aid Award in May, 2023. The GIA award is given to students conducting HVAC&R related research.


MA

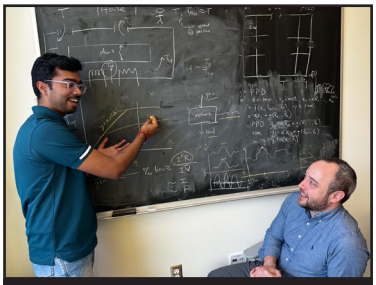
CUI


PERGANTIS

ZHUANG

Yongjie Zhuang received the Leo Beranek Student Medal for Excellence in the Study of Noise Control, given by the INCE (Institute of Noise Control Engineering). The Leo Beranek Medal was established by the Board of Directors of INCE/USA on October 24, 2010 to recognize excellence in the study of Noise Control Engineering. It is awarded annually to outstanding undergraduate and graduate students at those academic institutions in North America that have courses in, or related to, Noise Control Engineering, including practical applications.

Priyadarshan won the People's Choice award in the "Say it in 6" competition. It was sponsored by Purdue Graduate School, which challenges grad students to sum up their education in six words. Priyadarshan's entry – "Advisor, My Secret Ingredient to Success" – was a tribute to his advisor, Kevin Kircher.


PRIYADARSHAN

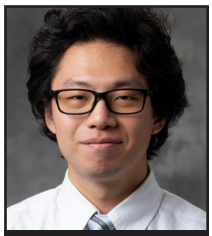
GHOSHAL

Pritam Ghoshal, a member of the ADAMS (Advanced Dynamics and MechanicS) Lab, jointly supervised by James Gibert and Anil K. Bajaj, won a best paper award in the ASME IDETC-CIE 2023 Conference in Boston for his work on the dynamic modelling of bistable viscoelastic trusses.

Andreas Hoess, Aaron Farha, and Junyan Ren teamed up with Ramin Ansari, a Ph.D. candidate in Civil Engineering, to create Team Herrick Labs, and finish 16th in the 2023 Purdue Grand Prix.

HOESS

FARHA

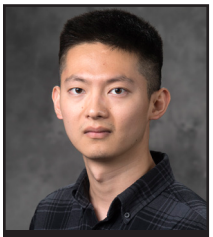

REN

HERRICK STUDENT AWARDS & SUCCESSES

CONFERENCE AWARDS

PERGANTIS

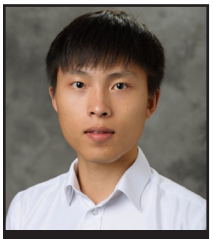
The prestigious 14th IEA Heat Pump Conference 2023, which took place in Chicago 15-18 May, witnessed the crowning of **Elias Pergantis** from Purdue University as the recipient of the Best Poster Award. Pergantis' groundbreaking research, titled "Thermodynamic Analysis of the Cascade Economization Cycle for High Temperature Heat Pump Applications," presented a novel solution to address the cost and coefficient of performance (COP) deterioration associated with sink-source temperature differences.


MA

Jiacheng Ma received the "First Runner Up" paper award at the American Modelica Conference 2022, Dallas, TX, Oct, 26, 2022. The conference paper was entitled "Transient Simulation of an Air-source Heat Pump under Cycling of Frosting and Reverse-cycle Defrosting". The Modelica Conference is the main event for users, library developers, tool vendors and language designers to share their knowledge and learn about the latest scientific and industrial progress related to Modelica, FMI, SSP, eFMI and DCP.

NAIR

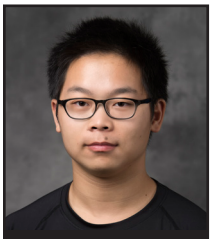
Siddharth Nair received the 2nd Best Paper Award at the SPIE Smart Structures + NDE -2023 conference under the Health Monitoring of Structural and Biological Systems session for his paper titled "A deep learning approach for the inverse shape design of 2D acoustic scatterers". The conference was held in Long Beach, California from March 12-16, 2023.


SONG

Guochenhao Song, a PhD student working with Prof. Bolton was the winner of the inaugural Best Written Paper Award, and placed third in the Student paper competition at the SAE Noise and Vibration Conference, Grand Rapids, June 2023.

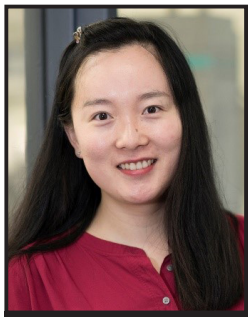
HAO

Haitian Hao was awarded the 2023 ASME Ephrahim Garcia Best Paper Award for the paper "On the use of negative thermal expansion engineered structures in flexural-mode solid-state thermoacoustics", J. Sound Vib. 538, 117223, 2023. This award was received at the at the 2023 SMASIS conference, a leading conference on adaptive structures and materials systems that attracts approximately 300 attendees each year with over 250 technical presentations.


DING

Wei Ding was a Finalist (runner up) for best student paper at the 2023 Engineering Mechanic Institute Conference (Elasticity Committee).

SELECT FACULTY SUCCESS STORIES



LI

The David and Lucile Packard Foundation awarded Assistant Professor **Tian Li** the Packard Fellowship for Science and Engineering which includes $875,000 over five years to pursue her research. Li was recognized for her work in high-performing sustainable materials to develop carbon-neutral technologies. Her group is redesigning natural materials, like wood, in order to establish a toolbox of materials for sustainable solutions for the carbon drawdown, across energy, water, environment and devices. She recently also received a $958,000 grant from ARPA-E to develop this "living wood" with the strength of steel, self-healing capabilities and combined carbon-sequestering benefits from wood and microbes, as well as the Violet B. Haas Fellowship supporting outstanding female researchers.

ZIVIANI

Assistant Professor **Davide Ziviani** was featured in a story involving the U.S. Department of Energy and its $3 million investment in Purdue University-led research showing promise to significantly reduce energy use and greenhouse gas emissions in large-scale manufacturing industries. Professor Ziviani is leading the three-year, multidisciplinary project involving industrial partners who have a major stake in the mission of decarbonizing the U.S. industrial sector: Trane Technologies, the Shrieve Chemical Co., the Convergent Science engineering software company, GTI Energy and Chemours Co., a chemical research firm. Other collaborators include Oak Ridge National Laboratory and the National Institute of Standards and Technology, which will support advanced manufacturing and working fluid characterizations, respectively.

Ziviani was also featured in a story involving The U.S. Department of Defense (DOD) and their partnership with Purdue University researchers to explore refrigerants that are both sustainable and safe to operate in combat conditions. Ziviani is leading a team that has received a three-year, $1.9 million grant from the Strategic Environmental Research and Development Program (SERDP), a program designed to increase the Department of Defense's environmental resilience.

SHAVER

In December of 2022, the EPA finalized stringent new tailpipe emissions requirements for trucks, based in part on research done by Professor **Greg Shaver** and his team at Herrick Labs. Through support from, and collaboration with, the U.S. Department of Energy and industry leaders Cummins Inc. and Eaton, Shaver's research has enabled diesel engine efficiency and emissions control through variable valve actuation, or VVA. His work was also cited in landmark regulation passed in California for on-road heavy-duty trucks in 2020, focused on reducing tailpipe nitrogen oxide emissions. Shaver was also given the Appreciation Award for developing top graduate students and providing them with international panel exposure at SAE COMVEC.

SELECT FACULTY SUCCESS STORIES

CIEZ

Assistant Professor **Rebecca Ciez** was featured in an article discussing how switching to renewable energy is an important step to reducing the effects of climate change, especially in heavy industry like steel mills. Ciez received a three-year $498,809 grant from the Alfred P. Sloan Foundation to assess the impacts of electrification and renewable energy use on manufacturing processes and job quality in the United States steel industry.

Ciez was also featured as a Scialog Fellow at the 2022 Scialog NES Conference and spoke about how the technical performance of decarbonization and negative emissions technologies interacts with economic considerations and decision-making processes to drive adoption.

BRAUN

Professor **Jim Braun** and Assistant Professor **Davide Ziviani** partnered with Assistant Professor **David Warsinger** to improve industrial drying with membranes. The team received a $2.4 million grant from the the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). Dehydrating is a vital part of many industrial processes, from food to chemicals to pharmaceuticals. Unfortunately, industrial drying processes require huge amounts of heat, which wastes valuable energy. This team is developing a new system that will reduce 50-80% of that energy usage using vapor-selective membranes.

WARSINGER

Warsinger also earned the Membranes Young Investigator Award, from the journal *Membranes*, which is awarded every two years and includes a $2,000 prize, and First Prize, in the Innovation Forum, for the International Desalination Association World Congress, in Sydney Australia which is a €6,000 prize.

JAIN

Associate Professor **Neera Jain** was given the NRC (National Research Council) Research Associateship award to work at the Air Force Research Laboratory in Kirtland Air Force Base, NM. Jain has also been named a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE).

Jain was also awarded the College of Engineering Graduate Student Mentorship Award at the 2023 Faculty & Lecturer Excellence Awards. Jain's students had glowing reviews of her caring and supportive mentoring style. They highlighted her communication skills, allowing her to set clear expectations and create a well-structured learning environment.

SELECT FACULTY SUCCESS STORIES

DYKE

Professor **Shirley Dyke** Dyke was selected by ASCE's Engineering Mechanics Institute to receive the 2022 George W. Housner Structural Control and Monitoring Medal for "ground-breaking research and innovative contributions to develop structural control and monitoring systems, as well as her dedication in the training and professional development of the next generation of engineers."

Dyke was awarded the Purdue University College of Engineering Faculty Excellence Award in Research (2023) for pioneering a machine learning technique that can detect, classify, and quantify damage in buildings subjected to seismic and wind hazards.

Dyke was also awarded the Outstanding Mentor of Engineering Graduate Students for Civil Engineering, Purdue University (2023). She was nominated by the graduate students in civil engineering for this recognition.

DAVIES

For her 35 years to educating students, future academics, and young professionals in the field of noise control engineering and her significant contributions to the profession, Professor **Patricia Davies** was awarded The INCE-USA Outstanding Educator Award for Excellence in the Teaching of Noise Control Engineering.

CAPPELLERI

Professsor **David J. Cappelleri** was named the B.F.S. Schaefer Scholar in the School of Mechanical Engineering in July 2022.

SEMPERLOTTI

Professsor **Fabio Semperlotti** attained a Membership Grade of Distiction from the American Society of Mechanical Engineers (ASME). The ASME Committee of Past Presidents confers the Fellow grade of membership on worthy candidates to recognize their outstanding engineering achievements.

BARTA

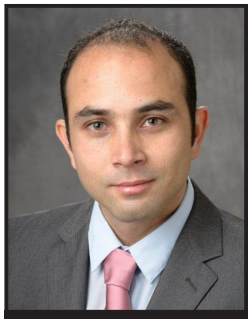
Assistant Professsor **Riley Barta** received the Young Scientists Award for outstanding research achievements in DKV's specialist fields, based on his Ph.D dissertation on CO2 refrigeration technology.

The U.S. Air Force Office of Scientific Research (AFOSR) has announced the latest group of grant recipients as part of its Young Investigator Research Program (YIP). Among the 2023 recipients is Assistant Professor **Monique McClain**, who will receive $450,000 over three years for her studies on additive manufacturing, especially in specialized areas

SELECT FACULTY SUCCESS STORIES

MCCLAIN

such as energetic materials. Her project is entitled "Enhanced Microstructural Control of Plastic Bonded Explosives via Additive Manufacturing."



ARIETTA

Associate Professor **Andres Arietta** worked on two programs funded by Wabash. The first program dealt with Integrated Analysis and Optimization of Next-Generation Refrigerated Electric Vehicle Units. This program included Davide Ziviani, Eckhard Groll, and Justin Weibel. Program two focused on Advanced Design from Multi-objective Optimization and Multifunctional Material Development and included James Gibert.

BISTABLE EMBRACE

Arietta also participated in Boiler Gold Rush (GBR) with an interactive art installation entitled: "Bistable Embrace". Bistable Embrace aimed to engage students and members of the public by bringing fundamental engineering research out of the lab environment and into the public space. Inspired by the research being conducted in the Programmable Structures Lab led by Arrieta, Bistable Embrace seeks to unveil the playful side of research through the exaggeration of scale.

Arietta was awarded an NIH Exploratory/Developmental Research Grant Award (R21) of $407,692 over two years to fund a project entitled: "Development of remotely actuated deformable membranes for in situ mechanical testing of soft tissue." Arietta worked alongside Adrian Buganza and Craig Goergen.

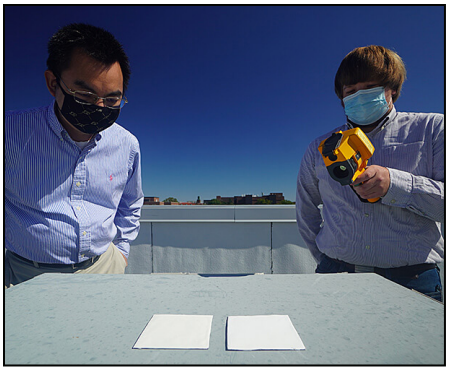
Arietta also co-authored a paper on Neuromorphic Metamaterials for Mechanosensing and Perceptual Associative Learning, which received high marks for media attention. AltMetric is a tool that measusres public interest and interaction with a published work. High marks with AltMetric shows that measures a paper's reach not only impacted the academic landscape, but also garnered high public interest. The AltMetric results of the paper can be viewed here: https://wiley.altmetric.com/details/137231919

STAFF AWARDS

LEE

Frank Lee was awarded the School of Mechanical Engineering Customer Service Award. Frank started his career at Purdue 28 years ago back in 1995. Frank currently serves as our Lead Engineering Technician at Herrick Laboratories and has been a well-respected and valued member of Herrick Labs for almost three decades. He is an exceptional employee who has made a huge impact on countless numbers of students and projects over the years. Frank has also done well to not only represent Herrick in a positive light but also demonstrate the Mechanical Engineering core values on a daily basis.

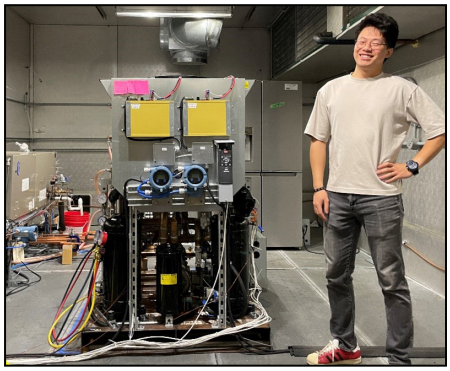
HERRICK SUCCESS STORIES



"Whitest Paint" testing done at Herrick continues to get national attention

NBC News visited the roof of Herrick labs to detail the story of Professor Xiulin Ruan's research into the "Whitest Paint" that could help cool down homes, neighborhoods and cities. The story was featured on NBC Nightly News in August. CNN ran a story about Ruan's research in July, and The New York Times focused an article about Guinness World Records recognizing the paint as the world's "whitest" in July as well.

Herrick Labs and Bechtel partner up



A team of researchers from Herrick Labs and Bechtel unveiled a potentially disruptive cooling technology for heating, ventilation, and air conditioning, or HVAC, systems, leading to substantial power savings in manufacturing and industrial buildings. Initial results show 5% higher efficiency in refrigeration systems. Marketed commercially as Crescendō, the technology uses a “regenerative” cooling cycle that captures energy that is lost in currently available cooling systems. The collaboration with the Bechtel team led to the development of a state-of-the-art hydrocarbon-based experimental setup to demonstrate the feasibility of the technology.

Herrick Conferences

In 1972, the first International Compressor Conference was held at Purdue University. Over fifty years later, the Herrick Conferences has grown to include the International Refrigeration & Air Conditioning Conference and the International High Performance Buildings Conference.

The 2024 Herrick Conferences will be held July 15 - 18, and will return to in-person only participation. We host nearly 900 of the world’s leading researchers, engineers, government officials and equipment users in the fields of compressors, HVAC&R systems and components, and high-performance buildings at our biannual conferences. Attendees and presenters come from more than thirty countries – including many European countries and the fast-developing regions of Asia, the Middle East, and Latin America. They will all come together for a four-day program that typically contains more than 450 papers, and over 600 participants.

HERRICK SUCCESS STORIES

Dean Arvind Raman Visit

Herrick Labs hosted a visit from Arvind Raman, Dean of the College of Engineering in June. Dean Raman toured the facilities and discussed all the amazing work being done. It was a great opportunity to showcase everything that Herrick has to offer, and reiterate the importance of what Herrick does for it's students, faculty, community, and Purdue.

Industrial Advisory Committee

The Industrial Advisory Committee (IAC) has continued to be an integral part of a successful relationship with industry and the labs. A special thank you to our 2022-2023 IAC Members:

Marcus Bianchi, National Renewable Energy Laboratory
Charles Boyer, C E Boyer& Associates LLC
Rudy Chervil, Daikin Applied Americas
Dan Conrad, Hussmann Corp.
Danan Dou, John Deere
Jon Douglas, Johnson Controls
Kirk Drees, The Drees Group, LLC
Daniel Fotsch, Rolls Royce Corporation
Paul Gloeckner, Cummins
Nishi Gupta, Change Logic
Darren Hallman, Self-Employed
Doug Hansel, Allison
Neal Herring, Raytheon Technologies
Ziqiang Hu, Midea
Michael Indenbaum, Herrick Foundation
Brian Joyal, Veridiam
Christopher Kafura, Carrier
Robert Lane, Wabash
Jason LeRoy, Trane Technologies
Mary Lombardo, Collins Aerospace
Ajay Iyengar, Lennox International Inc.
John Nalevanko, Ford
Terry Manon, Trane Company (retired)
Jim McCarthy, Eaton
Dave Mirth, Owens Corning
Mike Moaveni, Detroit Edison Company
Robert Parrin, Bobkat Partners, LLC
Kashmira Patel, Emerson
Brent Protzman, Lutron Electronics, Co., Inc.
Tim Roggenkamp, GM
Todd Rossi, Adjunct Professor
Steve Sorenson, Toyota Technical Center
Brad Till, Boeing Commercial Airplanes
Don Ufford, NIST
Fred Vance, Aero Technolgies

NEW HERRICK FACULTY

STARTED AUGUST 2023

RILEY BARTA

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

BARTA

Riley Barta was previously the Refrigeration Team Leader and Alexander von Humboldt Research Fellow at the Bitzer Chair of Refrigeration, Cryogenics and Compressor Technology at the Technical University of Dresden. He joined the Herrick faculty in August 2023. His research team conducts experimental and numerical research on vapor compression systems for a broad range of applications, waste heat utilization, refrigerant mixtures and behavior with lubricants, and aircraft fuel cell thermal management.

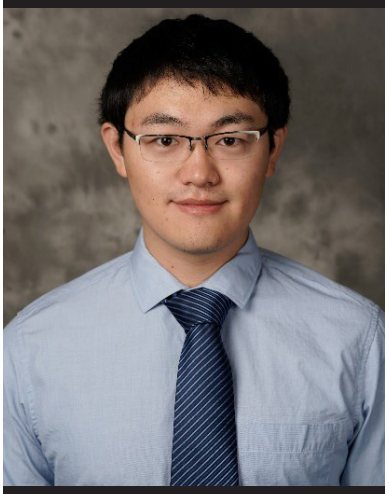
EDUCATION

- Ph.D. in Mechanical Engineering, Purdue University, '20
- MS in Mechanical Engineering, Purdue University, '16
- BS, Purdue University, '16

STARTED AUGUST 2023

JUNFEI LI

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING



LI

Junfei Li's research interest focuses on acoustic tweezers, acoustofluidics, ultrasound imaging, acoustic metamaterials, and noise control, with applications in healthcare, chemistry, robotics, and the audio industry. He joined the Herrick faculty in August 2023. Junfei has published over 40 journal articles and holds one U.S. Patent. His first-author publications have received recognition, including being named among the Top 50 Nature Communications articles in physics published in 2018, APL's Top 50 read articles published in 2016, and 2016 Smart Materials and Structures (SMS) Highlights Collection. Junfei is the recipient of several awards, including the Outstanding Dissertation Award from Duke University, the FIP John Chambers Scholarship, the China National Scholarship, and the Young Investigator Award from the Acoustical Society of America.

EDUCATION

- Ph.D. in Electrical and Computer Engineering, Duke University, '20
- BS, Beijing Institute of Technology, '15

NEW HERRICK FACULTY

WARSINGER

STARTED AUGUST 2023

DAVID WARSINGER

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

David completed his PhD at MIT with Professor John Lienhard, and did Postdoctoral work with Lienhard at MIT, Vecitis at Harvard (briefly), and with Menachem Elimelech and Jaehong Kim at Yale. Mentoring students is a priority for David, including for undergrad and graduate students. David is a coauthor of over 100 research contributions, including conference and journal papers, patents, and book chapters. David has been involved with advising, fundraising for, or cofounding several startup companies in the fields of water treatment, protection from pathogens, and food refrigeration.

EDUCATION

- Ph.D., Massachusetts Institute of Technology, '15
- M.Eng., Cornell University, '10
- B.S., Cornell University, '10

HOLLOWAY

STARTED APRIL 2023

ERIC HOLLOWAY

ASSISTANT PROFESSOR IN MECHANICAL ENGINEERING (BY COURTESY)

Eric completed his PhD at Purdue with Professors Kerrie Douglas and Bill Oakes, focused on how graduate students are prepared for professional practice, which was inspired by his time working at Herrick Labs. Eric's technical research at Herrick is focused on engine testbed and facilities, and his engineering education research is focused on students' professional development. Prior to returning to Purdue, Eric worked in industry for over 15 years for companies such as Toyota, Cummins, and TRW.

EDUCATION

- Ph.D., Engineering Education, Purdue University, '20
- MS in Industrial Engineering, Purdue University, '20
- BS, Purdue University, '92

NEW HERRICK STAFF

STARTED MARCH 2023

BEN PRICKEL

MARKETING & COMMUNICATIONS SPECIALIST

Ben Prickel brings over 20 years of marketing and communications experience to Herrick. He has extensive experience in website work, social media, and graphic design. He will be a valuable asset to help spread the word about all the great work being done at Herrick, as well as help facilitate Herrick conferences and other events.

STARTED APRIL 2023

VIVIAN SCOTT

SENIOR ADMINISTRATIVE ASSISTANT

Vivian has spent the last 16 years working for Purdue University's Dining Services as a Supply Management and Technical Assistant. She brings a wealth of Purdue experience and professionalism to the administrative team.

STARTED JULY 2023

CODY BAHLER

SENIOR ENGINEERING TECHNICIAN

Cody brings 8 years of experience in Purdue operations and maintenance to the Herrick team. His background is in electrical and building controls, and his experience and enthusiasm has served him well so far here at Herrick.

STARTED SEPTEMBER 2023

LEA GREATHOUSE

MANAGING DIRECTOR

Lea Greathouse joins Herrick Laboratories with 25 years of philanthropy and healthcare administration experience. She has an extensive track record of partnering with cross-functional departments across organizations to foster synergy, drive improvements, and build strategy to achieve shared goals. She has focused on creating cultures that promote accountability, diversity and inclusion, professional development and collaboration.

CENTER FOR HIGH PERFORMANCE BUILDINGS

CENTER FOR HIGH PERFORMANCE BUILDINGS AT PURDUE

FY2023 CHPB MEMBERSHIPS & PROJECT FUNDING

During the academic year 2022/23, the CHPB continued to grow the membership, support educational activities, and pursue large scale federal funding opportunities.

2023 CHPB MEMBERS

BELIMO, Carrier, COPELAND, DAIKIN, DUKE ENERGY, EMERSON, GE APPLIANCES a Haier company, GMCC, GREE, Honeywell, Johnson Controls, LENNOX, LG, Rheem, SOUTHERN CALIFORNIA EDISON An EDISON INTERNATIONAL® Company, TRANE TECHNOLOGIES

2024 NEW MEMBERS

BOSCH

16	13	3	15	20+
COMPANY MEMBERS	PROJECTS	SEED-FUNDED PROJECTS	FACULTY PIs	STUDENTS

CENTER FOR HIGH PERFORMANCE BUILDINGS

During the academic year 2022/23, the CHPB continued to grow the membership, support educational activities, and pursue large scale federal funding opportunities.

At the beginning of 2022, the CHPB membership included a total of 16 companies with a mix of equipment manufacturers and utilities. Following the 2022 CHPB Fall meeting activities, Regal Rexnord decided not to renew the membership. However, after the 2023 CHPB meeting, Bosch decided to join the center, maintaining the membership at 16 companies. As part of the 2022 CHPB Fall meeting (hosted as a hybrid event), 13 regular projects were selected along with 3 seed-funded projects. A total of 15 faculty PI/Co-PIs and 25 students (undergraduate/graduate students) were involved in CHPB-related activities.

In Spring 2022, a Center Leadership Council was formed to coordinate research and educational efforts with other centers such as CEEE at the University of Maryland, ACRC at the University of Urbana-Champaign, and CIBS at Oklahoma State University. Since then, the centers' leadership has met regularly at ASHRAE Winter and Annual events. Student exchange programs are being discussed along with large scale research opportunities.

Among the various CHPB activities, it is worthwhile mentioning key research and educational endeavors. Starting with research, CHPB led the first ever NSF Engine proposal[1], which was shortlisted among the top 34 semifinalists. While not selected for a Type-II award, the "NextHouse" Engine has been selected for a Type-I award. Moreover, CHPB-related projects yielded 5 major federal grants from the U.S. Department of Energy BTO/AMO/IEDO, ARPA-E, and the Department of Defense.

With respect to education, the CHPB has supported graduate students to travel to ASHRAE Winter and Annual Conferences as well as participation in the International Short-Course on Refrigeration and Compressors (IRCC)[2] . In addition, a team of students led by Prof. Ziviani competed in the "JUMP into STEM" program supported by the U.S. DOE BTO, and three national labs (ORNL, NREL and PNNL). The team was selected to participate in the final competition at NREL in January 2023, and was awarded with three summer internships at NREL and ORNL.

[1] *Regional Innovation Engines | NSF - National Science Foundation: https://new.nsf.gov/funding/initiatives/regional-innovation-engines*

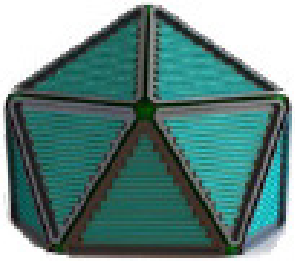
[2] *Keeping it cool: Germans and Americans collaborate on refrigeration - Mechanical Engineering - Purdue University: https://engineering.purdue.edu/ME/News/2023/keeping-it-cool-germans-and-americans-collaborate-on-refrigeration*

HERRICK CENTER UPDATES

RESILIENT EXTRA-TERRESTRIAL HABITAT INSTITUTE

The RETH institute held their annual review in-person on June 20-21, 2023. NASA reviewers and industry collaborators viewed demonstrations of the cyber-physical SmartHab testbed (CPT) and the human-computer interface, both being developed at Herrick Labs. The CPT, recently commissioned, aims to opportunistically couple realizable physical space habitat subsystems with computer modeled subsystems, to validate the institute's resilient design approach with real-world uncertainties. Julie Kramer-White, Director of Engineering at Johnson Space Center visited the CPT in Herrick Labs at Purdue on April 14, 2023. Learn more on the institute's website (https://www.purdue.edu/rethi/).

On October 13-14, 2022 the institute co-hosted an interdisciplinary workshop in San Antonio, Texas to establish a "cross-disciplinary academic, government, and industry community dedicated to identifying, developing, and evaluating applications of advanced technologies to support deep space exploration missions." To learn more (https://smarthabworkshop.org).



INTERNET OF THINGS 4 PRECISION AGRICULTURE

IoT4Ag was established on September 1, 2020. In Year 3, the Center has continued the excellent growth and execution of its programs and activities that deliver on the IoT4Ag strategic plan across the four foundational components: *convergent research, engineering workforce development, diversity and culture of inclusion, and innovation ecosystem*.

Participants in Y3 of IoT4Ag Research include: 6 Postdoctoral Associates, 72 graduate students, and 40 undergraduate students. Additionally, there were 13 IoT4Ag-themed capstone design projects across the partner institutions impacting an additional 57 undergraduate students.

HERRICK CENTER UPDATES

Highlights of achievements from the past year are listed below:

- Center-wide:
  Another great IoT4Ag student-led "boot camp" (June 13-14) and Annual Retreat (June 14-16). This time students, REUs, faculty, staff, and advisory board members gathered in-person at the University of Florida and the North Florida Research and Education Center at Live Oak.

- Convergent Research:
  Corn Phenology, Biomass and Nitrogen Efficiency Prediction from Integrated Sensors Project: This cross-thrust project collected extensive field reference and multi-modality sensor data from UAVs over the growing season at multiple sites with different environments (soils/weather) and nitrogen practices, refined canopy-level specific nutrient stress indicators and developed predictive models that improved capabilities of abiotic stress during corn growth.

- Engineering Workforce Development:
  New partnership established with the Junior Minorities In Agricultural, Natural Resources, And Related Sciences (MANNRS) organization, in which three workshops were conducted to middle and high school students with 140 attendees.

- Diversity and Culture of Inclusion:
  The Pathways to Ph.D. Program (PPP) received 120 applications in September 2022, including 70 undergraduate students and 19 graduate students participating in the 1-day online workshop to learn about graduate school and the application process. More than half of the mentees identified as Black, Latino, or Asian, demonstrating that this program is providing access to graduate student opportunities for a diverse student population.

- Innovation Ecosystem:
  IoT4Ag added 4 new invention disclosures during Year 3 and filed 3 patent applications (for lifetime total of 7 disclosures and 6 patent applications).

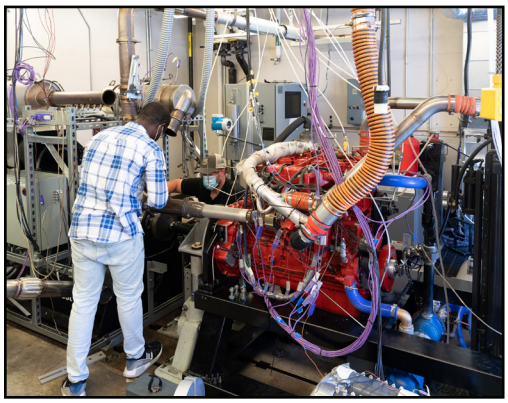
MAJOR RESEARCH FACILITIES

THE WILLIS CARRIER THERMAL SYSTEMS LABORATORIES

These areas are where the HVAC and Refrigeration component-level and system-level technology research is conducted, as well as research on Air Quality. Three pairs of psychrometric chambers: each 7,000 cubic feet, with 5-ton testing capacity and precise temperature and humidity control. Designed to accommodate ASHRAE/ARI test procedures. Sixteen geothermal bores: 300 feet deep, with variable flow rates and numerous temperature sensors. A 90-ton centrifugal chiller and ice storage test facility; computer-controlled compressor load stands; psychrometric wind tunnel with dust injection system. There are two indoor air quality (IAQ) laboratories that can simulate indoor and outdoor conditions. Instrumentation includes ultrasonic anemometers, omni-directional anemometers, tracer-gas sampler and analyzer, and particle generators and analyzers.

THE GERALD HINES SUSTAINABLE BUILDINGS TECHNOLOGY LABORATORY

Herrick Laboratories is a living laboratory where the built environment is being studied. It includes a 16 bore geothermal field and plug-and-play heat rejection for experiments in the engines and thermal sciences laboratories. Four, almost-identical 34′ x 37′ office spaces for human-building interaction and building technology studies; completely customizable temperature, humidity, airflow patterns, and acoustic treatments; reconfigurable indoor lighting, daylighting/shading controls, mechanical cooling and ventilation controls, and more; thermal delivery by ceiling, floor or side walls, including radiant-floor heating and radiant-chilled beam cooling; replaceable south-facing building envelopes. The normal temperature range is 65° F to 75° F but this can be extended to 55° F to 85° F. Relative humidity can be varied from 20% to 80%. Three of the units have double skin facades with different options for ventilation and energy recovery. All of the offices spaces have separate equipment for providing space conditioning that are well instrumented to allow direct energy comparisons.

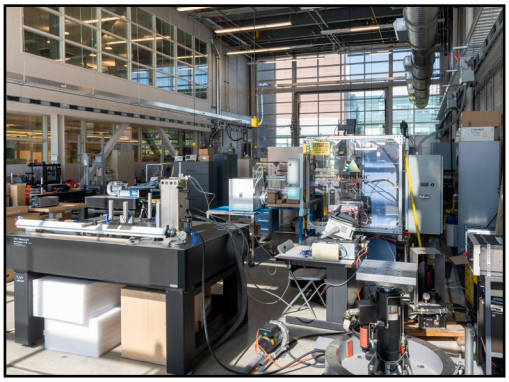


THE CUMMINS POWER LABORATORY

There are four test cells that are home to engine and hybrid systems controls research that is focused on improving efficiency, reducing engine emissions and developing efficient and environmentally friendly systems for using alternative fuels. The four test cells support 670, 350, 150 and 150 HP engine testing, respectively. A hydraulic variable valve actuation system capable of controlling 12 valves, a single cylinder rig for testing piezoelectric valve actuation, and an AC dynamometer and several eddy-current engine dynamometers, as well as emissions sensing systems.

MAJOR RESEARCH FACILITIES

ROGER B. GATEWOOD HIGH-BAY FLEXIBLE LABORATORY & SMALL-SCALE VIBRATIONS LABORATORY

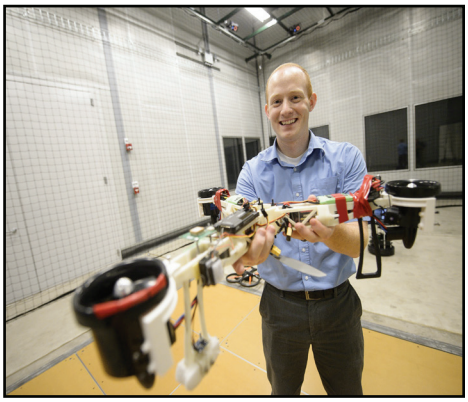


These spaces house electro-mechanical systems, additive manufacturing, and vibrations research. This is comprised of two parts: an open 36 by 87 ft. high-bay area with segmented floors for vibration isolation between experiments, and a smaller laboratory for smaller scale experiments. The high-bay area has high ceilings to accommodate large systems for testing. It can house large shakers, such as a 35 kN TIRA electrodynamic shaker that can be used to reproduce vibration profiles and has in-built hydraulic power supplies for hydraulic shakers. In this area, the vibration and dynamics of larger structures can be examined such as building components, vehicle suspension systems, wind turbine blades, road vehicle and aircraft and space structures. The 700 sq. ft. small-scale laboratory includes apparatus for the dynamic testing of materials and small structures to investigate nonlinear dynamic behavior and to identify structural and material parameters.

ACOUSTICS, NOISE AND VIBRATION RESEARCH AREA

In addition to the facilities in the High-Bay Flexible Laboratory and Perception-Based Engineering areas, these facilities include a 25 by 20 by 18 ft. reverberation room, an anechoic room with useful volume of 12 by 12 by 12 ft., a hemi anechoic room with useful volume of 41 by 27 by 18 ft. and an 8 by 8 ft. audiometric room for sound quality testing. There is also an acoustical materials laboratory with several types of impedance tubes for standardized acoustic material testing. The reverberation room is configured for sound transmission testing of acoustical systems. Additional facilities include a tire pavement test apparatus (TPTA) for testing tires on realistic pavements at speeds up to 50 km/hr, a two wheel chassis dynamometer with 67 inch rollers, an anechoic wind tunnel with 18 by 24 inch test section and flow velocity up 120 mph. Instrumentation includes a 64 microphone acoustical holography array and 90 channel data acquisition system, various microphones, accelerometers, shakers, laser vibrometers, and a high-speed camera.

FORD PERCEPTION-BASED ENGINEERING LABORATORY



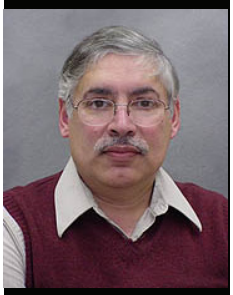
Perception-Based Engineering (PBE) researchers study people's perceptions of stimuli, their influence on satisfaction, comfort, annoyance and performance and the relationship between those outcomes and the system, design and operational parameters. PBE faculty at Purdue work on projects related to touch interfaces, sound and vibration quality, image quality and depth perception, display design and graphics optimization, effects of noise on performance, and human-computer interaction. This 43 ft. by 28 ft. laboratory houses a TEAM 6 degree-of-freedom shaker, which can be covered when not in use. Lighting, temperature (55° F - 85° F), humidity (20% to 80%) and sound can be finely controlled, and the room can be re-configured as several small isolated rooms or one larger room, thus simulating various types of environments.

2023 HERRICK FACULTY

ANDRES ARRIETA

ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING
PH.D., UNIVERSITY OF BRISTOL, UNITED KINGDOM, '10

RESEARCH INTERESTS:
Adaptive structures ▪ Mechanical metamaterials ▪ Robotic materials ▪ Programmable structures ▪ Multistable structures ▪ Structural nonlinearity ▪ Elastic instabilities ▪ Structural dynamics ▪ Nonlinear vibrations



ANIL K. BAJAJ

ALPHA P. JAMISON PROFESSOR OF MECHANICAL ENGINEERING
PH.D., UNIVERSITY OF MINNESOTA, '81

RESEARCH INTERESTS:
Modeling of nonlinear systems ▪ Structural dynamics and localization ▪ Flow-induced vibrations ▪ Impacting systems ▪ Bifurcations and chaos

RILEY BARTA

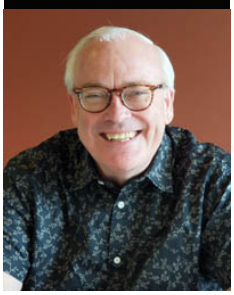
ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
B.S., PURDUE UNIVERSITY, '16, PH.D., PURDUE UNIVERSITY, '20

RESEARCH INTERESTS:
Modeling and Analysis of Thermal Systems ▪ Heat Pumping, Air Conditioning and Refrigeration Technologies ▪ High Performance Buildings ▪ Refrigerant and Lubricant Properties

ERNEST BLATCHLEY

LEE A. RIETH PROFESSOR IN ENVIRONMENTAL ENGINEERING
B.S., PURDUE UNIVERSITY '81, M.S., UNIVERSITY OF CALIFORNIA, BERKELEY '83, PH.D., UNIVERSITY OF CALIFORNIA, BERKELEY '88

RESEARCH INTERESTS:
Design and analysis of ultraviolet (UV) systems for disinfection of indoor air; methods to quantify and validate the performance of UV disinfection systems for indoor air.

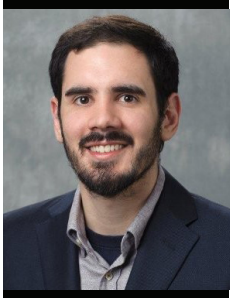


J. STUART BOLTON

PROFESSOR OF MECHANICAL ENGINEERING
PH.D. SOUTHAMPTON, '84

RESEARCH INTERESTS:
Acoustics ▪ Active and passive noise control ▪ Sound field visualization ▪ Structural acoustics and wave propagation in structures ▪ Noise control material modeling ▪ Applied signal processing

2023 HERRICK FACULTY



BRANDON E BOOR

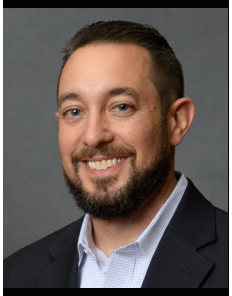
ASSOCIATE PROFESSOR OF CIVIL ENGINEERING
PH.D., THE UNIVERSITY OF TEXAS AT AUSTIN, '15

RESEARCH INTERESTS:
Indoor air quality (IAQ) ▪ HVAC filtration ▪ Human exposure assessment ▪ Airborne nanoparticles ▪ Bioaerosols (fungi, bacteria, pollen, allergens) ▪ Air quality in occupational workplaces ▪ Particle adhesion & resuspension ▪ Early-life/infant exposures ▪ Combustion aerosols & wood smoke ▪ New particle formation ▪ Urban air pollution ▪ Low-cost air quality monitoring ▪ Health effects of air pollution ▪ Fate & transport of VOCs/SVOCs.

JAMES E. BRAUN

HERRICK PROFESSOR OF ENGINEERING
DIRECTOR OF THE CENTER FOR HIGH PERFORMANCE BUILDINGS
PH.D., UNIVERSITY OF WISCONSIN, '88

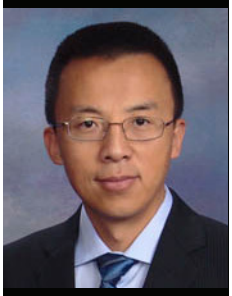
RESEARCH INTERESTS:
Modeling, analysis, and control of thermal systems



DAVID J. CAPPELLERI

PROFESSOR OF BIOMEDICAL ENGINEERING (BY COURTESY)
PH.D., UNIVERSITY OF PENNSYLVANIA, '08

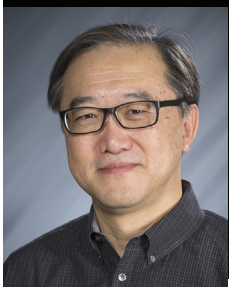
RESEARCH INTERESTS:
Multi-scale robotic manipulation and assembly, mobile microrobotics, unmanned aerial and ground vehicle design and control, agricultural robotics, mobile manipulation, medical robotics, and automation for the life sciences



JUN CHEN

ASSISTANT HEAD FOR FACILITIES AND OPERATIONS
ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING
PH.D., JOHNS HOPKINS UNIVERSITY, '04

RESEARCH INTERESTS:
Experimental fluid dynamics ▪ Development of flow diagnostic techniques ▪ Flow dynamics in stratified environment ▪ Turbulent flow measurements and modeling



GEORGE T. C. CHIU

ASSISTANT DEAN FOR GLOBAL ENGINEERING PROGRAMS
PROFESSOR OF MECHANICAL ENGINEERING
PH.D., UNIVERSITY OF CALIFORNIA-BERKELEY, '94

RESEARCH INTERESTS:
Dynamic systems and control ▪ Mechatronics ▪ Digital and functional printing and fabrication ▪ Motion and vibration control and perception ▪ Embedded systems and real-time control

2023 HERRICK FACULTY

REBECCA CIEZ

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
PH.D., CARNEGIE MELLON UNIVERSITY, '18

RESEARCH INTERESTS:
Energy technologies ▪ Economics ▪ Decision-making processes ▪ Decarbonized energy systems

PATRICIA DAVIES

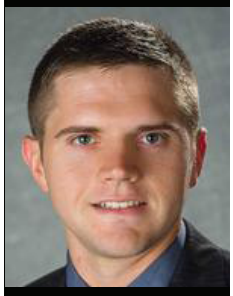
PROFESSOR OF MECHANICAL ENGINEERING
PH.D., SOUTHAMPTON, '85

RESEARCH INTERESTS:
Sound quality ▪ Signal processing ▪ Data analysis ▪ System modeling and identification ▪ Condition monitoring of machinery ▪ Perception-based engineering ▪ Seat-occupant modeling

SHIRLEY J. DYKE

PROFESSOR OF MECHANICAL ENGINEERING AND CIVIL ENGINEERING
PH.D., UNIVERSITY OF NOTRE DAME, '96

RESEARCH INTERESTS:
Structural dynamics and control ▪ Cyber-physical systems ▪ Machine vision ▪ Real-time hybrid simulation ▪ Damage detection and structural condition monitoring ▪ Cyberinfrastructure development



JOHN T. EVANS IV

ASSISTANT PROFESSOR OF AGRICULTRAL AND BIOLOGICAL ENGINEERING
COURTESY APPOINTMENT IN MECHANICAL ENGINEERING
B.S., UNIVERSITY OF KENTUCKY , '13 , M.S., UNIVERSITY OF KENTUCKY , '15 , PH.D., UNIVERSITY OF NEBRASKA, '18

RESEARCH INTERESTS:
Automation and Autonomy ▪ Machine Logistics ▪ Cropping Systems Technologies ▪ Vehicle Simulation and Testing

JAMES GIBERT

ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING
PH.D., CLEMSON UNIVERSITY, '09

RESEARCH INTERESTS:
Vibrations and nonlinear dynamics ▪ Smart material systems ▪ Non-pneumatic tires ▪ Optimization of mechanical systems ▪ Additive manufacturing

2023 HERRICK FACULTY

MARCIAL GONZALEZ

ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING
PH.D., CALIFORNIA INSTITUTE OF TECHNOLOGY, '11

RESEARCH INTERESTS:
Predictive, multi-scale modeling and simulation of microstructure evolution in confined granular systems, with an emphasis in manufacturing processes and the relationship between product fabrication and performance ▪ Particulate products and processes ▪ Continuous manufacturing ▪ Performance of pharmaceutical solid products

ECKHARD A. GROLL

WILLIAM E. AND FLORENCE E. PERRY HEAD OF MECHANICAL ENGINEERING
REILLY PROFESSOR OF MECHANICAL ENGINEERING
"DOKTOR-INGENIEUR" (DOCTOR OF ENGINEERING), UNIVERSITY OF HANNOVER, '94

RESEARCH INTERESTS:
Thermal sciences as applied to HVAC&R systems and equipment

SOGAND MOHAMMAD HASANZADEH

ASSISTANT PROFESSOR OF CIVIL ENGINEERING
PH.D., VIRGINIA TECH, '20

RESEARCH INTERESTS:
Digital Twins ▪ Thermal Stress and Human Factors▪ Wearable Technologies ▪ Human-Robot Teaming ▪ Smart Safety and Advanced Sensing

ERIC HOLLOWAY

SENIOR DIRECTOR OF INDUSTRY RESEARCH
ASSISTANT PROFESSOR IN MECHANICAL ENGINEERING (BY COURTESY)
PH.D., PURDUE UNIVERSITY, '20

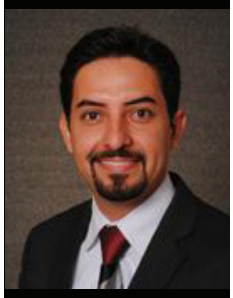
RESEARCH INTERESTS:
Engine testbed and facilities, and students' professional development

W. TRAVIS HORTON

PROFESSOR OF CIVIL ENGINEERING
PH.D., PURDUE UNIVERSITY, '02

RESEARCH INTERESTS:
Advanced thermal energy conversion systems ▪ Energy utilization in buildings, and the interactions between a building and its environment ▪ Development of advanced, highly integrated, heating, ventilating, air conditioning, and refrigeration systems

2023 HERRICK FACULTY



MOHAMMAD REZA JAHANSHAHI

ASSOCIATE PROFESSOR OF CIVIL ENGINEERING
PH.D., UNIVERSITY OF SOUTHERN CALIFORNIA, '11

RESEARCH INTERESTS:
Autonomous sensing ▪ Data interpretation ▪ Intelligent condition assessment of structures

NEERA JAIN

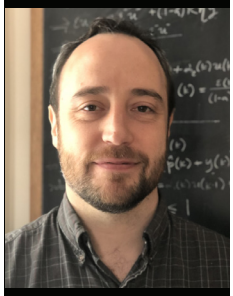
ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING
PH.D., UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, '13

RESEARCH INTERESTS:
Dynamic modeling and optimal control ▪ Model predictive control ▪ Decentralized control ▪ Thermodynamics-based optimization ▪ Entropy generation minimization ▪ Exergy analysis ▪ Integrated energy management and storage in distributed energy systems ▪ Building systems

PANAGIOTA KARAVA

JACK AND KAY HOCKEMA PROFESSOR OF CIVIL ENGINEERING
PH.D., CONCORDIA UNIVERSITY, '08

RESEARCH INTERESTS:
Smart buildings, intelligent building operation, system identification, model predictive control ▪ Human-building interactions, personalized control, self-tuned environments ▪ Smart and connected energy-aware residential communities ▪ Energy efficient and mixed-mode buildings, innovative energy and comfort delivery systems ▪ Solar technology integration in building operation



KEVIN KIRCHER

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
PH.D., CORNELL UNIVERSITY, '19

RESEARCH INTERESTS:
Control, optimization, and machine learning methods for energy systems in buildings, focusing on their interactions with the power grid ▪ New technologies for efficient electric heating ▪ Validation methods through field experiments ▪ Collaboration with campus building operators.

CHARLES M. KROUSGRILL

150TH ANNIVERSARY PROFESSOR OF MECHANICAL ENGINEERING
PH.D., CALIFORNIA INSTITUTE OF TECHNOLOGY, '80

RESEARCH INTERESTS:
Dynamics ▪ Nonlinear vibration of continuous systems ▪ Stability analysis

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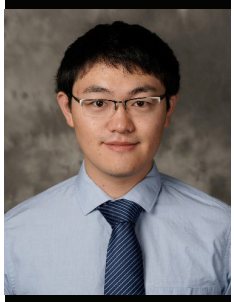
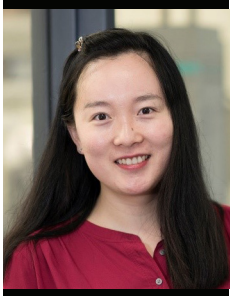


JUNFEI LI

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

RESEARCH INTERESTS:
Acoustic tweezers ▪ acoustofluidics ▪ ultrasound imaging ▪ acoustic metamaterials ▪ noise control



TIAN LI

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
PH.D. UNIVERSITY OF MARYLAND, '15

RESEARCH INTERESTS:
Naturally nanostructured materials ▪ Energy, water, and wearable technology ▪ Manufacturing

YANGFAN LIU

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
PH.D., PURDUE UNIVERSITY, '16

RESEARCH INTERESTS:
Acoustic Source Modeling and sound field reconstruction ▪ Active noise control ▪ Room acoustics simulation and auralization ▪ Noise control treatments ▪ Human perception of noise

MONIQUE MCCLAIN

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
PH.D., PURDUE UNIVERSITY

RESEARCH INTERESTS:
Dissimilar material 3D printing ▪ Additive manufacturing of energetic materials ▪ Additive manufacturing of materials for high temperature applications ▪ Quality control in additive manufacturing

PETER H. MECKL

PROFESSOR OF MECHANICAL ENGINEERING
PH.D., MASSACHUSETTS INSTITUTE OF TECHNOLOGY, '88

RESEARCH INTERESTS:
Motion and vibration control ▪ Adaptive control ▪ Intelligent control using fuzzy logic and neural networks ▪ Engine and emissions diagnostics ▪ Robotics

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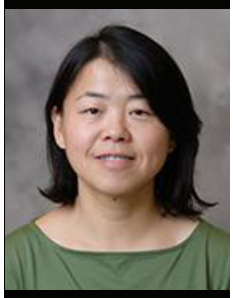


MING QU

PROFESSOR OF CIVIL ENGINEERING
PH.D., CARNEGIE MELLON UNIVERSITY, '08

RESEARCH INTERESTS:
Solar cooling and heating systems ▪ Building heat transfer ▪ Building energy supply systems ▪ Building controls and operations ▪ Building and building system modeling & simulation ▪ Sustainable building design and analysis ▪ Building system integration dedicated to sustainable and healthy built environments

JULIO A RAMIREZ

KARL H. KETTELHUT PROFESSOR OF CIVIL ENGINEERING
NHERI-NCO CENTER DIRECTOR
PH.D., UNIVERSITY OF TEXAS AT AUSTIN, '83

RESEARCH INTERESTS:
Structural analysis and design of reinforced and prestressed concrete structures, with emphasis on seismic performance of concrete buildings and infrastructure ▪ Structural models and experimental methods ▪ Design codes for structural concrete

FABIO SEMPERLOTTI

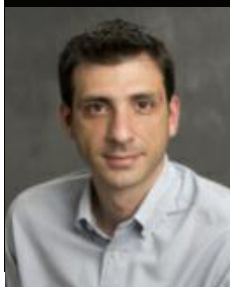
PROFESSOR OF MECHANICAL ENGINEERING
PH.D., THE PENNSYLVANIA STATE UNIVERSITY, '09

RESEARCH INTERESTS:
Structural health monitoring ▪ Wave propagation ▪ Structural dynamics and vibration control ▪ Adaptive structures ▪ Periodic structures and acoustic metamaterials ▪ Energy harvesting ▪ Thermoacoustics

GREGORY M. SHAVER

PROFESSOR OF MECHANICAL ENGINEERING
PH.D., STANFORD UNIVERSITY, '05

RESEARCH INTERESTS:
Model-based system and control design of commercial vehicle power trains ▪ Connected and automated commercial vehicles ▪ Internal combustion engine & after-treatment system design and controls ▪ Flexible valve actuation in diesel and natural gas engines



ATHANASIOS (THANOS) TZEMPELIKOS

PROFESSOR OF CIVIL ENGINEERING
PH.D., CONCORDIA UNIVERSITY, '05

RESEARCH INTERESTS:
Design, operation and optimization of high performance buildings ▪ Daylighting, design and control of dynamic facade and shading systems ▪ Indoor environmental (thermal and visual) quality and comfort ▪ Occupant preferences and interaction with building systems ▪ Radiant building systems ▪ Solar energy applications in buildings ▪ Building energy modeling and simulation

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DAVID WARSINGER

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

RESEARCH INTERESTS:
Desalination & Water Treatment ▪ Water-Food-Energy Nexus ▪ Thermofluids Nanotechnology
Membrane Science

BIN YAO

PROFESSOR OF MECHANICAL ENGINEERING
PH.D., UNIVERSITY OF CALIFORNIA-BERKELEY, '96

RESEARCH INTERESTS:
Adaptive and robust control ▪ Nonlinear control ▪ Precision control of mechanical systems
▪ Vehicle control ▪ Robotics

DAVIDE ZIVIANI

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
ASSOCIATE DIRECTOR OF THE CENTER FOR HIGH PERFORMANCE BUILDINGS
PH.D., GHENT UNIVERSITY (BELGIUM), '17

RESEARCH INTERESTS:
Advanced heat pumping/heat engine technologies and their equipment ▪ Positive displacement compressors and expanders ▪ High performance buildings ▪ Thermal management systems

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FACULTY PUBLICATIONS

Recent Herrick faculty publications can be found

on the Herrick website.

2023 HERRICK STAFF

CODY BAHLER
SENIOR ENGINEERING TECHNICIAN

VICKY DEARDURFF
CUSTODIAL SERVICES

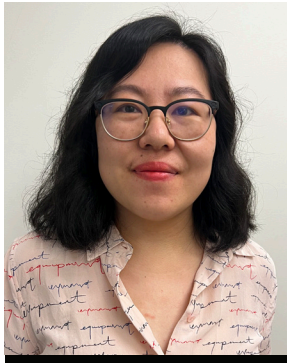
HEMANTH DEVARAPALLI
CHPB SR. RESEARCH SUPPORT ANALYST

BRYCE GEESEY
LEAD RESEARCH ENGINEER

LEA GREATHOUSE
MANAGING DIRECTOR

KWOK (FRANK) LEE
LEAD ENGINEERING TECHNICIAN

JOSE LOPEZ ROMERO
ENGINEERING TECHNICIAN



JIE MA
SENIOR RESEARCH ASSOCIATE

BEN PRICKEL
MARKETING & COMMS SPECIALIST

VIVIAN SCOTT
SR. ADMINISTRATIVE ASSISTANT

ALEX VAN ALLEN
RESEARCH FACILITY DEVELOPMENT & OPERATIONS MNGR.

2023 HERRICK POST DOC RESEARCH ASSOC.

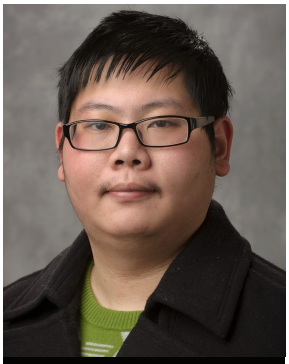
FRANCESCO DANZI

ZAMZAM GOLMOHAMMADI

ALANA LUND

CHUNJIAN PAN

YIMING WANG



HONGFEI ZHU

HUIJEONG KIM

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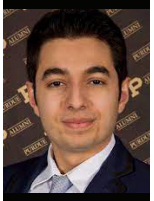


AARON AFRIAT

DEGREE: M.S., 2022 **PROFESSOR:** STEVEN F. SON

THESIS: SERDP GUN PROPELLANT

MICHAEL ANTHONY

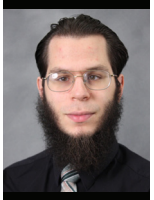
DEGREE: M.S., 2022 **PROFESSOR:** GREGORY M. SHAVER

THESIS: NOVEL THREE-WAY CATALYST EMISSIONS REDUCTION AND GT-POWER ENGINE MODELING

JOHN BREHM

DEGREE: M.S., 2022 **PROFESSOR:** ECKHARD A. GROLL / DAVIDE ZIVIANI

THESIS: IMPACT OF HIGH-EFFICIENCY AND VARIABLE-SPEED MOTORS ON THE PERFORMANCE OF A RESIDENTIAL SPLIT-SYSTEM HEAT PUMP



DANIEL CARR

DEGREE: PH.D., 2021 **PROFESSOR:** PATRICIA DAVIES

THESIS: PERCEPTION OF WIND NOISE IN VEHICLES

JACOB BORIS

DEGREE: M.S., 2022 **PROFESSOR:** JAMES GILBERT

THESIS: EMBEDDED SENSORS IN 3D-PRINTED CERAMICS FOR BALLISTIC ARMORAPPLICATIONS

WON HONG CHOI

DEGREE: PH.D., 2023 **PROFESSOR:** J. STUART BOLTON

THESIS: A LABORATORY PROCEDURE FOR MEASURING THE DISPERSION CHARACTERISTICS OF LOADED TIRES

PARVEEN DHILLON

DEGREE: PH.D., 2022 **PROFESSOR:** JAMES E. BRAUN

THESIS: LOAD-BASED TESTING TO CHARACTERIZE THE PERFORMANCE OF RTUS WITH INTEGRATED ECONOMIZERS

FY 2023 HERRICK LAB GRADUATES

MARCIN GLEBOCKI

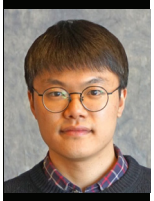
DEGREE: M.S., 2022 **PROFESSOR:** NEERA JAIN

THESIS: TRANSIENT THERMAL MANAGEMENT FOR AIR VEHICLES

KAUSHAL KAMAL JAIN

DEGREE: PH.D., 2022 **PROFESSOR:** PETER H. MECKL

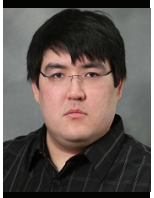
THESIS: MODEL-BASED ON-BOARD DIAGNOSTICS FOR SCR-ASC



JUNYOUNG KIM

DEGREE: PH.D., 2023 **PROFESSOR:** JAMES E. BRAUN

THESIS: EVALUATION OF CHEMICAL LOOPING HEAT PUMP CYCLE



MATTHEW KONISHI

DEGREE: M.S., 2023 **PROFESSOR:** NEERA JAIN

THESIS: MULTI-TIMESCALE MODELING OF HUMAN TRUST IN AUTOMATION

SRINATH KULKARNI

DEGREE: M.S., 2022 **PROFESSOR:** FABIO SEMPERLOTTI

NON-THESIS

XIAOYU LIU

DEGREE: PH.D., 2022 **PROFESSOR:** SHIRLEY J. DYKE

THESIS: AUTOMATED IMAGE LOCALIZATION AND DAMAGE LEVEL EVALUATION FOR RAPID POST-EVENT BUILDING ASSESSMENT

HARITH MORGAN

DEGREE: M.S., 2022 **PROFESSOR:** ANDRES ARRIETTA

THESIS: HYBRID MATERIALS FOR MORPHOLOGIC COMPUTATION

2023 HERRICK LAB GRADUATES

SANSIT PATNAIK

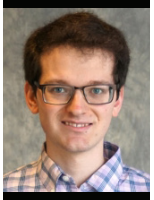
DEGREE: PH.D., 2022 **PROFESSOR:** FABIO SEMPERLOTTI

THESIS: FRACTIONAL-ORDER STRUCTURAL MECHANICS: THEORY AND APPLICATIONS

JOEY PINAKIDIS

DEGREE: M.S., 2022 **PROFESSOR:** JEFFREY RHOADS

THESIS: CUI



MICHAEL SHANKS

DEGREE: M.S., 2022 **PROFESSOR:** NEERA JAIN

THESIS: DESIGN, CONTROL, AND VALIDATION OF A TRANSIENT THERMAL MANAGEMENT SYSTEM WITH INTEGRATED PHASE-CHANGE THERMAL ENERGY STORAGE

DONI THOMAS

DEGREE: MS., 2022 **PROFESSOR:** GREGORY M. SHAVER

THESIS: EXPERIMENTAL SETUP AND TESTING OF A VIABLE VALVE ACTUATION ENABLED CAM-LESS NATURAL GAS ENGINE

YUNPENG XU

DEGREE: PH.D., 2022 **PROFESSOR:** GREGORY M. SHAVER

THESIS: FRACTIONAL OXIDATION STATE CONTROL OF THREE-WAY CATALYST WITH STOICHIOMETRIC SPARK-IGNITION NATURAL GAS ENGINES INCORPORATING CYLINDER DEACTIVATION

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