

AEROGRAM

PURDUE UNIVERSITY SCHOOL OF AERONAUTICS AND ASTRONAUTICS / FALL 2017



DESTINATION: DEEP SPACE MARS AND BEYOND

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AEROGRAM

is an annual publication for the alumni and friends of Purdue University School of Aeronautics and Astronautics.

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ROOKIE RACER

Graduate student Nicoletta Fala (above, right) was the pilot on the first AAE sponsored Air Race Classic team in June 2017. Fala, a native of Nicosia, Cyprus, is a PhD student studying aerospace systems and general aviation safety under Professor Karen Marais. Fala earned her bachelor's and master's degrees from Purdue AAE in 2014.

Fala and her co-pilot, Chloé de Perre (left), a chemist in the Department of Agronomy and native of France, finished 22nd in the 41st annual Air Race Classic. Fala won the Rookie Racer Award.

More than 100 women in 52 planes participated in this year's race, a 2,652 mile, all female airplane race across the United States. The race took off from Frederick, Maryland, on June 20 and ended in Santa Fe, New Mexico, on June 23.

The race is the oldest of its kind in the country, tracing its roots back to the 1929 Women's Air Derby, where Amelia Earhart and other female pilots raced from Santa Monica, California, to Cleveland, Ohio. The winner is determined by which team beats its handicap speed by the largest margin over the course of the race.

Fala and de Perre are both members of Purdue Pilots Inc., a student-run flying club open to anyone in the Purdue community. The Piper Warrior II aircraft they flew during the race is owned by the club.

PHOTOS: PURDUE PILOTS INC.

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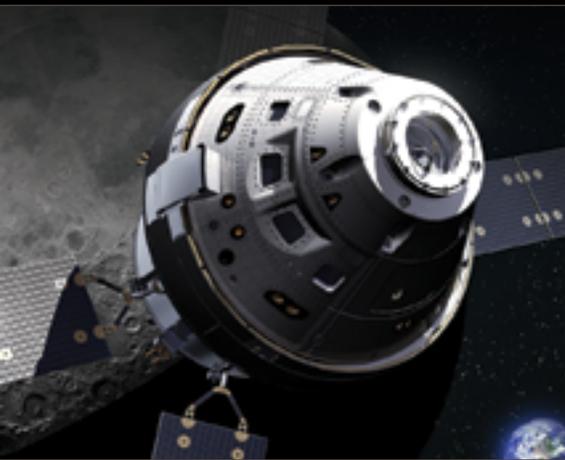


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LAUNCHPAD

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NASA's Orion spacecraft will carry astronauts to destinations beyond Earth orbit to Mars, support the crew during travel and provide safe re entry to Earth.

PHOTO: LOCKHEED MARTIN,
ARTIST COMPOSITE

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TOM I-P. SHIH

J. WILLIAM UHRIG AND ANASTASIA VOURNAS HEAD AND PROFESSOR OF AERONAUTICS AND ASTRONAUTICS

GREETINGS from the School of Aeronautics and Astronautics at Purdue University! In this Aeroqram, we are excited to share news and stories from the 2016-17 academic year.

Our faculty were once again recognized with numerous awards. These include Professor Kathleen Howell being elected to the National Academy of Engineering and the American Academy of Arts and Sciences and Professor Wayne Chen being awarded an honorary doctorate. Also, Professor Dan DeLaurentis was appointed as the inaugural director of Purdue's Institute of Global Security and Defense Innovation. And our school was honored to have my headship named, thanks to a generous gift from Bill Uhrig and Anastasia Vournas. The funding from this endowed headship makes possible continued enhancements in the quality of education that we provide to our students. Also, after long and successful careers, professors Dominick Andrisani and Dave Filmer retired. We are extremely grateful for their many years of dedicated service and outstanding contributions.

Our students have been involved in exciting activities within and outside the classroom. Also, our enrollment keeps growing with incredibly outstanding and passionate students! In 2016-17, AAE graduated 323 students — 167 with a BS, 124 with an MS and 32 with a PhD.

Our alumni continue to be a source of great pride. In April 2017, we honored nine highly accomplished alumni with our Outstanding Aerospace Engineer Award. AAE alumna Amy Hess won the

Distinguished Engineering Alumni Award, the highest honor our college can bestow upon an engineering alum. Another alumna, Loral O'Hara, is among the 12 individuals announced as NASA's newest astronaut candidates!

There were also exciting developments in education, research and engagement. Professor Bill Anderson was recently awarded an AFOSR Center of Excellence in Multi-Fidelity Modeling of Combustion Dynamics with Michigan and MIT. In March, Purdue celebrated the opening of the first facility in the University's new Aerospace District. The goal of the \$33 million partnership with Rolls-Royce is to design, develop and test next-generation jet engine components. The expansion of the Maurice J. Zucrow Laboratories, made possible as part of a \$40 million Lilly Endowment grant, is now complete, securing the facility's place as one of the nation's foremost propulsion laboratories.

Of course, all of this wouldn't be possible without your support. We are happy to report that AAE placed third overall in the 2017 Purdue Day of Giving, raising more than \$3.1 million to help us continue the excellence!

In this Aeroqram, you will learn more about these and other stories. We thank you for your support throughout the past year. Please stop by and visit if you're ever on campus. Also, please let us know about the exciting things happening in your lives so that we can share them in next year's Aeroqram!

Hail Purdue!

Tom I-P. Shih



DESTINATION: DEEP SPACE

MARS AND BEYOND

Purdue's School of
AERONAUTICS AND ASTRONAUTICS,
an engine on the nation's path
to space exploration



IN HIS BOOK, “PALE BLUE DOT,” Carl Sagan puts it succinctly: “All civilizations become either spacefaring or extinct.” In 2014, perhaps with Sagan’s notion in mind, the National Academies of Science, Engineering and Medicine released a key report called the “Pathways to Exploration: Rationales and Approaches for a U.S. Program of Human Space Exploration.” The document argued that the expense and danger of spaceflight can be justified by the goal of putting humans on other worlds, starting with Mars. Purdue’s own president, Mitch Daniels, co-chaired the report committee and testified before Congress on the subject. In March of this year, President Donald Trump renewed the mandate, signing a bill authorizing \$19.5 billion in funding for NASA.

NASA’s plan for Mars

Getting humans to Mars is NASA’s immediate objective. The target year is 2033, when planetary orbits align for the swiftest flight to Mars.

NASA’s Space Launch System, its most powerful heavy-lift rocket to date, will launch the manned Orion spacecraft into deep space. The reusable craft will transport a crew of four, sustain the crew during the journey and provide safe re-entry to Earth. NASA expects the mission to last approximately three years: about 18 months of travel and 18 months of exploration.

An unmanned test is planned for 2019. “For the first mission, we’re going to take Orion and fly it

around the moon. Uncrewed,” says Dan Dumbacher, Purdue professor of practice in the School of Aeronautics and Astronautics.

Dumbacher would know. Until 2014, this AAE alum served as deputy associate administrator of NASA’s Human Exploration and Operations Mission Directorate. He focused on exploration systems development, which encompasses the Space Launch System, Orion, and Ground Systems Development and Operations. Now on the faculty at Purdue, Dumbacher remains attuned to mission development at NASA — and to advances in the private space industry on which NASA relies.

“We will exercise orbits that have never been used before — orbits that AAE Professor Kathleen Howell was instrumental in coming up with,” Dumbacher adds. Howell, the Hsu Lo Distinguished Professor of Aeronautics and Astronautics, has worked with NASA’s Jet Propulsion Laboratory to create an “interplanetary superhighway,” a method that enables spacecraft to travel through the solar system by taking advantage of the gravitational attractions of the sun and planets.

Orion’s first crewed test mission likely will occur in 2022. The test mission will verify that the systems, including the re-entry system, work as planned. The next phase is the Deep Space Gateway, a space station NASA envisions as a staging ground for deep space missions. Construction is slated for the 2020s.

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Artist concept of the SLS Block 1 configuration. PHOTO: NASA



Purdue's influence

Purdue may be the cradle of astronauts, but arguably more impressive is Purdue's pervasive influence on deep space exploration. Like a gold and black tide, Purdue alums are ubiquitous in NASA and in the burgeoning space industry. In addition to 23 astronauts who are Purdue alums — plus recently selected astronaut candidate Loral O'Hara (MSAAE '09) who will be a candidate for Orion missions — numerous AAE grads work as top program managers at NASA. They include:

- Bill Gerstenmaier, associate administrator for human exploration and operations.
- Mark Geyer, deputy director of the Johnson Space Center in Houston.
- Julie Kramer White, chief engineer for the Orion Multi-Purpose Crew Exploration Vehicle program.
- Anna-Maria Rivas McGowan, senior engineer for complex systems design.

In addition to high-ranking personnel, Purdue has more than 60 graduates who are directly involved in the Orion program through their work at NASA, Lockheed Martin and Honeywell. These alumni hold positions in thermal control systems, avionics, guidance, software, propulsion, mechanical systems,

crew module, ground handling and other fields. Purdue also has a major partnership with Lockheed Martin, which is the prime contractor for Orion. There are 781 Purdue alumni working at Lockheed Martin in 82 different locations worldwide.

The Purdue brain trust

As NASA's complex projects move ahead, Purdue sits in an interesting position. "We are unique in the world in terms of reputation and research background in space," Dumbacher says. "Purdue is part of the brain trust that solves the technical problems that no one has solved before."

One example is the Advanced Astrodynamics Concepts research group run by professors James Longuski and Sarag Saikia. With expertise in end-to-end human-Mars architecture design, the AAC may be the world's top lab studying human-to-Mars exploration. Longuski and Saikia (who studied under Longuski) work closely with former astronaut Buzz Aldrin on designing cycler trajectories.

Currently, Longuski and Saikia are studying architectures, assessing technical scenarios, and designing mission architecture design tools. The AAC lab looks at prospective goals and weighs the costs and risks of each architecture. The design for a permanent base on Mars differs from that of a short-

AAE EXPERTS IN SPACE EXPLORATION

ALINA ALEXEENKO

Professor of Aeronautics and Astronautics

EXPERTISE: High-altitude aerothermodynamics and micropropulsion

DAN DUMBACHER

Professor of Engineering Practice

EXPERTISE: Systems engineering, NASA project management

CAROLIN FRUEH

Assistant Professor of Aeronautics and Astronautics

EXPERTISE: Space situational awareness (satellites, debris and near earth objects), space object characterization, satellite guidance, navigation and control, astrodynamics, sensor tasking, low observability systems, information quantification and retrieval

JAMES GARRISON

Professor of Aeronautics and Astronautics

EXPERTISE: Earth remote sensing, global navigation satellite systems (GNSS), bistatic radar, signals of opportunity

KATHLEEN HOWELL

Hsu Lo Distinguished Professor of Aeronautics and Astronautics

EXPERTISE: Orbit mechanics, spacecraft dynamics, control, trajectory optimization

JAMES LONGUSKI

Professor of Aeronautics and Astronautics

EXPERTISE: Spacecraft dynamics, orbit mechanics, control, orbit decay and re entry

KAREN MARAIS

Associate Professor of Aeronautics and Astronautics

EXPERTISE: Safety and risk analysis, financial modeling of engineering systems, environmental impacts of technology

SARAG SAIKIA

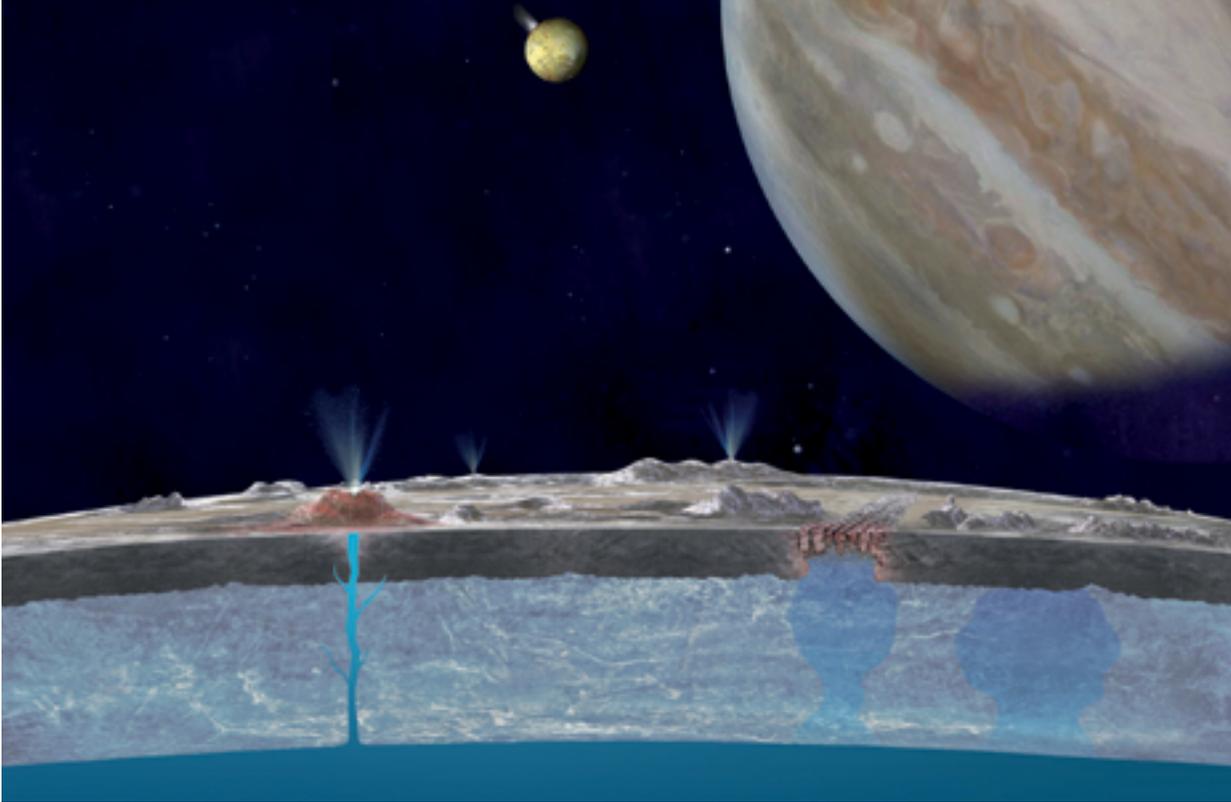
Visiting Assistant Professor of Aeronautics and Astronautics

EXPERTISE: Conceptual mission design, entry, descent, and landing, spacecraft systems engineering, end to end human exploration architecture design

DAVID SPENCER

Associate Professor of Aeronautics and Astronautics

EXPERTISE: Planetary mission design, small satellites, system engineering, mission operations and project management



Artist's impression of chloride salts bubbling up from Europa's liquid ocean and reaching the frozen surface, where they are bombarded with volcanic sulfur from Io, another of Jupiter's moons. PHOTO: NASA/JPL-CALTECH

term expedition. Longuski's and Saikia's analyses will enable NASA to make key decisions about mission components and costs.

With his students, Saikia recently completed a yearlong study called the Human Journey to Mars, which designed a research base for 50 humans on the red planet akin to the Amundsen-Scott South Pole Station. The project culminated in April 2017 with a symposium on campus that was attended by influential individuals from NASA and the space industry. "Based on this study, we will be working with the NASA human-to-Mars team later this year," Saikia says.

Deep space research at Purdue

In the late 2020s or early 2030s, NASA plans to send an unmanned mission to Uranus or Neptune. NASA has contracted with the AAC team to study the impact of advanced technologies on mission architectures for such a journey.

Aerocapture. In particular, Longuski and Saikia are studying a concept called "aerocapture," the idea that skimming a high-speed spacecraft along a planet's upper atmosphere can work as a braking mechanism, a low-energy way to slow the spacecraft's approach. "If we can do that," Saikia says, "we can save a tremendous amount of time and mass, which equates to big cost savings in space exploration." The team recently received follow-up funding from JPL to continue this research.

Ocean worlds. NASA also is eager to study the planetary bodies in our solar system most likely to harbor life, Europa and Enceladus, which are moons of Jupiter and Saturn, respectively. The moons' surfaces are water ice, and satellite observations indicate that their interiors are global oceans. In 2022-23, NASA will send an orbiter to Jupiter, a project that includes a static lander on Europa. A rover to one of these distant and very cold ocean worlds — minus 352 degrees Fahrenheit — will enable the exploration of the surfaces at multiple locations.

"If we can prove that the genesis of life can be different from that of Earth, it will be a huge discovery," Saikia says.

An integral component of NASA's long-term plan for deep space, the AAC team recently won a contract to develop a rover with innovative tire design that will operate on the rough, icy surface of Europa or Enceladus. "As part of the project, we are designing a tire-testing facility that will be one of the best in the world," Saikia says.

AAE's community of practice

To establish a stronger presence in the field of commercial deep space exploration, Purdue AAE recently partnered with the Coalition for Deep Space Exploration, an influential nonprofit

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International Space Station after undocking. PHOTO: WIKIMEDIA

industry group. In league with this 60-plus-member coalition, the school is assembling a formal community of practice — a faculty team with the academic brainpower to solve tough problems presented by commercial deep space travel.

The coalition includes traditional aerospace companies such as Boeing and Lockheed Martin and space startups that specialize in things like robotic payloads (Astrobotics), asteroid mining (Deep Space Industries) and construction and manufacturing in space (Made in Space). These companies are looking to Purdue for answers.

The community of practice comprises colleagues from within AAE — and from all over the University — with expertise in fields pertinent to deep space travel. For example, Purdue's Resilient Extraterrestrial Habitats team is researching ways to build safe, long-term settlements on the moon and Mars. That effort includes faculty in civil, mechanical, and aero- and astronautical engineering — as well as in planetary sciences.

“The community-of-practice initiative is a pilot project with the Coalition for Deep Space Exploration,” Dumbacher says. “It is significant that they chose to start with Purdue.”

Multidisciplinary work. As well as obvious space and propulsion applications, researchers at Purdue have much to offer the space industry in areas such as lightweight structures with newly invented materials currently under development by AAE professors Daniel DeLaurentis and William Crossley. In groundbreaking satellite research, Professor James Garrison invented the underlying concept behind a NASA-funded mission to improve hurricane forecasting by measuring ocean-surface winds with micro-satellite observatories. The Cyclone Global Navigation Satellite System (CYGNSS)

launched in December 2016, and the first data are expected later this year. Other vital areas include:

- Biomedical research — discovering ways to maintain and protect human bodies in space.
- Business and ag economic research — examining public policies for seeding the space economy.
- Psychological research — researching ways humans can mentally and emotionally cope while living in space for long periods.
- Near-space research — tracking orbital debris and discovering ways to mitigate it.

The space economy

A healthy, sustainable space economy may be the linchpin that convinces American taxpayers that space exploration is worth funding. Entrepreneurial companies such as SpaceX, Blue Origin and others are looking for economic opportunities in space. “I think helping them be successful is the absolute key to the long-term sustainability of the space exploration enterprise as a whole,” Dumbacher says.

He equates the budding space economy to the budding commercial airline industry of the 1920s. Government investment in things like airmail contracts provided early incentives for the airline industry. The space economy has not reached that stage yet. “We’re at the very beginning.”

For their part, professors Saikia and Longuski are prepared to join Purdue's community of practice and work with industry partners to help educate the next generation. “I tell people that we need to live up to Neil Armstrong's legacy, to maintain his stature,” Saikia says. “We have to do ambitious work.”

FLYING HIGH

Loral O'Hara becomes Purdue's 24th astronaut

NASA has selected Purdue alum Loral O'Hara (MSAAE '09) as one of its newest astronauts. O'Hara joins a rich heritage of 23 Purdue alumni to become NASA astronauts, but is only the third woman to do so, following Janice Voss and Mary Ellen Weber.

O'Hara credits her Purdue Aeronautics and Astronautics degree and connections to the University community for creating the building blocks to her success.

"Purdue AAE gave me a strong foundation from which to begin a career as a researcher," she says. "But perhaps more valuable than any single technical skill is the community I became a part of as a Purdue graduate. This network has been hugely beneficial for everything from job opportunities to seeking advice to solving a technical problem."

Purdue's influence also helped to direct the course

of her career, particularly her rocket propulsion class with Stephen Heister, the Raisbeck Engineering Distinguished Professor for Engineering and Technology Integration, and her work at Zucrow Labs. "It was my first time doing a lot of hands-on design, assembly and test work," she says. "I discovered I loved it."

In August, O'Hara began a rigorous two-year training program in which she'll learn the Russian language and how to spacewalk, fly a T-38 jet, and operate robotics and space systems. But the rigor excites her.

"In the past, with the space shuttle they could send up experts in just one field because missions were shorter and the teams were larger," she says. "But with the International Space Station and longer missions, you have to be very broad in your expertise."

Ultimately, O'Hara wants to research extreme environments on Mars or the moon. But for all the work she has done to get to this point, the skies still take her breath away.

"Every time I look at the moon, I think, 'Holy cow, I might be walking around up there someday — that's actually a real possibility,'" O'Hara says.

O'Hara says.



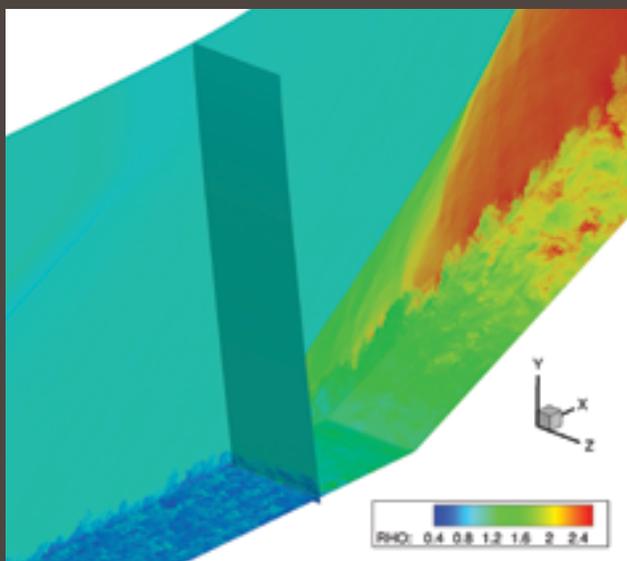
Supercomputer replaces
wind tunnel for AAE professor

DIGITAL VORTEX

JONATHAN POGGIE'S HIGH SPEED FLUID MECHANICS RESEARCH AIMS TO MAKE SUPERSONIC FLIGHT MORE EFFICIENT, BUT HE DOESN'T NEED A PHYSICAL WIND TUNNEL TO TEST HIS THEORIES. HE HAS ACCESS TO SOME OF THE LARGEST SUPERCOMPUTERS IN THE WORLD.

Poggie, an associate professor of aeronautics and astronautics, studies fluid mechanics in the supersonic and hypersonic (greater than five times the speed of sound) regimes. In particular, he studies separation unsteadiness and laminar-turbulent transition. "Separation" is an undesirable recirculating flow over an aircraft, and "transition" is a difficult-to-predict change from orderly laminar flow to chaotic turbulent flow. The common themes in the two areas are undesirable drag, heating and mechanical loads. Poggie looks for ways to predict and control these phenomena, and he analyzes devices that can be used to control flow.

"It's a lot faster to try out different ideas for flow control on the computer than it is in the wind tunnel, and it's a lot cheaper, especially in the high-speed regime," he explains. "Running a hypersonic wind tunnel costs millions of dollars, and it's something we can prototype on the computer in just a few hours."



A close up of the separated flow over a ramp at Mach 2.25 shows the complex turbulent flow near the bottom wall and unsteady shocks farther away. From work carried out by Kevin Porter (MS '17) under Poggie's DoE INCITE Award.

But not on just any computer. High-performance computing is essential to Poggie's research, due to the way fluid flow must be broken up into grid cells to be modeled. Using a larger number of smaller cells creates more accurate models that can capture turbulence on a smaller scale; but, it requires a supercomputer's parallel processing capabilities to perform the calculations efficiently. Poggie's group carries out direct numerical simulations with billions of cells on many thousands of processors, using computers such as Argonne National Laboratory's Mira and the Air Force Research Laboratory's Thunder. For code development and testing, his group runs smaller jobs on Purdue Community Cluster Program machines, such as Halstead.



JONATHAN POGGIE

Formerly with the Air Force Research Laboratory, Poggie served as a technical team leader and program manager, focusing on technology to enable flight at extremely high speed — supersonic and hypersonic aircraft.

Poggie's work is supported by computer hours through Purdue University, a Department of Energy INCITE Award and a Department of Defense Frontier Project. He also is supported through research grants from the Air Force Office of Scientific Research and the Office of Naval Research.

CENTER OF EXCELLENCE IN MULTI-FIDELITY MODELING OF COMBUSTION DYNAMICS

Researchers from the School of AAE were selected by the Air Force Office of Scientific Research and the Air Force Research Laboratory to participate in the multi university Center of Excellence in Multi Fidelity Modeling of Combustion Dynamics.

"Combustion instability is one of the most complex problems that can be encountered during the development of chemical propulsion systems," says Professor William Anderson, who serves as the principal investigator at Purdue.



WILLIAM ANDERSON

Enabled by advances in high fidelity computational fluid dynamics, adaptive reduced models and data driven modeling, the center will develop and demonstrate mathematically derived reduced order models and physically inspired reduced fidelity models to efficiently and accurately predict combustion dynamics.

The University of Michigan led center is funded for \$4.2 million for six years, including a two year renewal option. The award includes the Massachusetts Institute of Technology as well as Purdue. Along with Bill Anderson, investigators at Purdue include Charles Merkle, the Reilly Professor of Engineering, and Swanand Sardeshmukh, PhD, researcher. "With support from NASA, AFRL, and AFOSR, we have been using concurrent simulation and experimentation to improve our understanding of combustion dynamics for the past decade," Anderson says. "This center brings together experts in combustion instability and advanced multi physics and multi scale modeling to take the next big step toward a truly predictive capability."

"It is especially difficult in rocket engines because energy addition rates are so extreme, on the order of a terawatt per cubic meter, and because the rocket combustor environment is so inaccessible to detailed measurement."

Enabled by advances in high fidelity

computational fluid dynamics, adaptive reduced models and data driven modeling, the center will develop and demonstrate mathematically derived reduced order models and physically inspired reduced fidelity models to efficiently and accurately predict combustion dynamics.

SMART POWER

Two AAE research projects funded through U.S. Navy partnership

Of six Purdue projects funded through a partnership with the U.S. Navy, two AAE research teams have received grants of \$450,000 each.

The U.S. Navy Enterprise Partnership Teaming with Universities for National Excellence (NEPTUNE) was launched by Purdue and the Navy in 2014 to help the military branch reach its goal to convert half of its energy consumption to alternative sources, including biofuels, by 2020.

“These interdisciplinary projects came from a diverse lineup of nearly 30 submitted proposals in energy storage, renewable energy technologies, high energy and pulsed power, smart grid, flexible electronics, energy efficiency and systems engineering,” says Maureen McCann, director of the Purdue Energy Center in Discovery Park, who chairs the proposal selection committee. “The depth of the campus projects was impressive, and the deep engagement this process is creating between Purdue and the U.S. Navy is something we continue to build on.” McCann is also a professor of biological sciences.

The first newly funded project is In-Situ Examination of Thermal Runaway in Lithium

Ion Batteries under Dynamic Loading and at High Temperatures Using Nanomechanical Raman Spectroscopy. It is led by Vikas Tomar, professor of aeronautics and astronautics; Vilas G. Pol, professor of chemical engineering; and Tom Adams, scientist at the Naval Surface Warfare Center, Crane Division.

The second project is Low-Cost Catalyst for Portable Hydrogen Generation and On-Demand Power, led by Timothée Pourpoint, professor of aeronautics and astronautics.

Purdue President Mitch Daniels and Navy Secretary Ray Mabus announced an agreement in 2014 to develop research efforts aimed at addressing the goal by the Navy and Marine Corps to generate at least 50 percent of their energy from alternative sources. In addition, Purdue and the Navy have partnered on more than 600 research projects valued at \$80 million in the past decade.

In September 2015, Purdue Energy Center faculty received grants totaling \$3 million from the Office of Naval Research for the pilot phase of the NEPTUNE program, focused on developing a power and energy course and establishing a research facility for testing aviation fuels from biomass.

Purdue was chosen to be a lead university in the NEPTUNE pilot because of its strengths in basic science and engineering research and its commitment to providing educational opportunities to current, former and future members of the military through the Purdue Military Research Initiative.

Integration of Navy officers, veterans and ROTC students into cutting-edge research programs is a critical facet of NEPTUNE.



TIMOTHÉE POURPOINT



VIKAS TOMAR

GLOBAL SECURITY AND DEFENSE INNOVATION

Professor DeLaurentis selected as director of new Purdue institute

Dan DeLaurentis, Purdue professor of aeronautics and astronautics and President's Fellow for Defense Initiatives, is the director of the new Institute for Global Security and Defense Innovation. President Mitch Daniels announced Dec. 1 that the University was opening the institute in Discovery Park.

The institute works with Purdue's other research centers and institutes to research areas such as advanced instrumentation, nanotechnology, social and behavioral sciences, big data analytics, and simulations to deliver integrated systems solutions to the nation's security and defense community.

In the 2016 fiscal year, Purdue received more than \$50 million for advanced defense-related research projects. The new institute will centralize defense and security research efforts across campus, and could make Purdue the preeminent university in national defense and security.

DeLaurentis says that not all discoveries will be from bench science or engineering — behavioral and social science will be equally important.

"We must develop teams that can understand and then address threats in a manner that integrates technical, social and

policy factors," he says. "These issues must be confronted holistically when we develop pathways to greater security."

Tomás Díaz de la Rubia, chief scientist and executive director of Purdue's Discovery Park, said that the United

States has gained a

technological advantage,

or "offset," in each of the past major conflicts. Nuclear weapons, stealth technologies, global positioning and accuracy are all examples of ways the U.S. has stayed ahead of its adversaries. But to stay ahead now, the U.S. should be in a state of continuous development, or continuous offset, he says.

"We can no longer rely on decades of military superiority via so-called technology 'offsets.' Countries around the world are innovating and advancing, whether it is quantum computing, cryptography, or hypersonic weapons, or artificial intelligence; the gap is closing fast," he says. "In the future, we must out-invent, out-discover and out-innovate our adversaries every day."



DAN DELAURENTIS





STRENGTH

IN STRUCTURE

New engineering consortium partnering with Indiana industry

AAE was selected in January to be part of a new consortium of Purdue Engineering faculty and facilities with expertise in simulation-based engineering of materials and structures, which is now offering partnerships with Indiana-based manufacturers.

Michael Sangid, assistant professor of AAE, is a key member of the group. Research in his Advanced Computational Materials and Experimental Evaluation lab combines knowledge of materials science, solid mechanics, and advanced manufacturing to solve complex problems in materials behavior and processing.

The Indiana Consortium for Simulation-Based Engineering of Materials and Structures (ICSEMS) formed in January 2017. It also includes members of Purdue’s School of Mechanical Engineering and Lyles School of Civil Engineering.

“It’s designed to be a mutually beneficial partnership,” says Thomas Siegmund, professor of mechanical engineering. “Manufacturers can benefit from our expertise in computational modeling, and Purdue students and faculty can benefit from conducting that research in real-world environments.”

Simulation-based engineering refers to the computer modeling of materials, specifically in stress and deformation analysis, fatigue and fracture, shape optimization, and material selection.

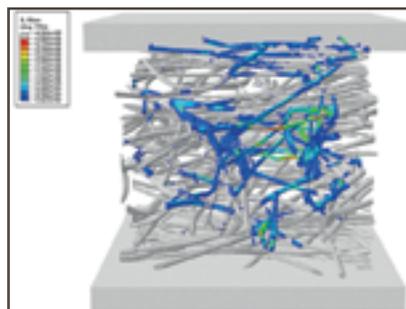
In a real-life case study, Purdue faculty have been working with Knauf Insulation in Shelbyville, Indiana, a manufacturer of glass fiber insulation materials. During the introduction of a new insulation material into the marketplace, Knauf engineers worked with Purdue faculty to better understand and fine-tune the material microstructure. Purdue researchers simulated the material microstructure and its deformation and failure response in the computer, and determined how forces are distributed internally to the material. Based on the collaboration with Purdue faculty, Knauf Insulation implemented several new techniques into their processes.

Consortium members’ technical expertise and computational infrastructure can be useful in many industries, including automotive, aerospace, civil infrastructure, biomedical, materials, defense and consumer products.

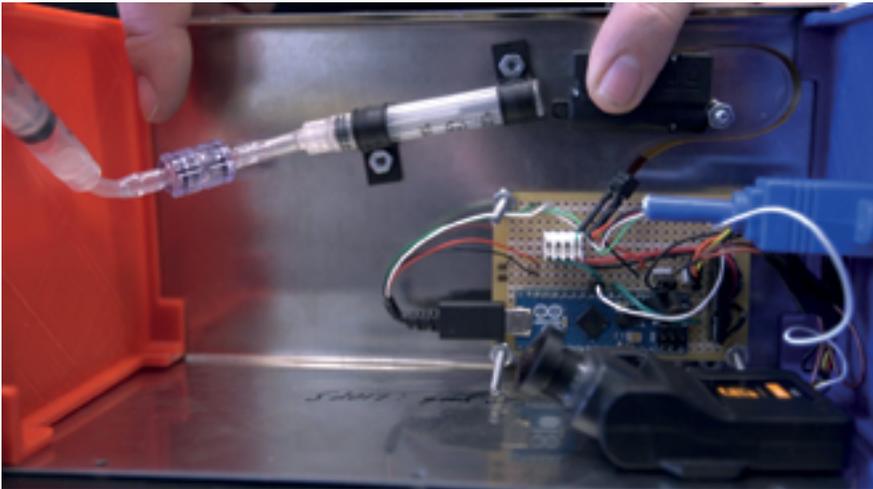
The consortium also offers training for the engineering workforce as well as a platform for running open-source simulation software.

“We’re looking forward to what Indiana manufacturers can accomplish when they team up with our simulation-based engineers,” Siegmund says.

ICSEMS is a part of the Indiana Next Generation Manufacturing Competitiveness Center, which aims to sustain manufacturing growth and leadership in the state of Indiana.



In an example of how simulation based engineering can assist manufacturers, Purdue demonstrated to Knauf Insulation how mechanical loads are transmitted in porous glass fiber materials. PHOTOS: COLLEGE OF ENGINEERING



The Zero-Gravity Glow experiment is expected to launch on a Blue Origin suborbital rocket later this year. PHOTO: COLLEGE OF ENGINEERING

Project taps second-graders to help with **SUBORBITAL ROCKET PROJECT**

For more than two years, Purdue AAE students have helped students at Cumberland Elementary School perfect an experiment testing whether the Say's Firefly can glow in a zero-gravity environment.

Steven Collicott, PhD, professor of aeronautics and astronautics, says the Zero-Gravity Glow Experiment will launch on a Blue Origin suborbital rocket later this year.

Collicott says as many as 25 aerospace engineering students have helped the second-graders with the project, including interacting through classroom visits and demonstrations.

"I was pleasantly surprised with the intense interest of the second-graders in all aspects of the experiment, from how high or fast the rocket goes to a question about if we will have enough dissolved oxygen in the chemical solutions for the glowing reaction to happen," Collicott says.

The automated experiment weighs one pound and connects to the rocket's computer via a USB cable that supplies electrical power and a digital signal with news about how the flight is progressing.

A microcomputer listens to signals from the rocket. When weightlessness begins, the controller turns on a high-definition video camera and recorder as well as a device that pushes the plunger of a syringe.

Collicott says the syringe injects one of the firefly chemicals into the other, causing the reaction to occur. The experiment recording will continue through descent and landing.

"I want to stress that we are seeking to lead the way in STEM outreach," he says. "This exact launch opportunity is available to all schools in the years ahead."

Collicott is no stranger to the Blue Origin rocket launches. He was one of three scientists asked by Blue Origin to work with the private company as it tested and perfected its suborbital rocket design.

An experiment by Collicott testing the physics of liquid movement in zero-gravity situations was carried in the payload of a rocket that launched on June 19, 2017, from a private location in Texas.

CONNECTING SPACE EXPLORATION AND BIOTECHNOLOGY

Blossoming connections between space exploration and the fields of biology and biotechnology were the focus of a speaking event featuring Purdue AAE alumnus Bill Gerstenmaier (BSAAE '77).

"Biotech and Space: What We Know to Boldly Go" took place on Oct. 27, 2016, in Stewart Center's Fowler Hall. It featured presentations by Gerstenmaier, associate administrator for human exploration and operations for NASA, and Michael Ladisch, Distinguished Professor of Biomedical Engineering. They discussed how space discoveries can be applied on Earth as well as to applications in the next frontier.

Gerstenmaier focused his talk on DNA sequencing and food science in space. Ladisch's lecture examined how fundamental bioengineering research is influencing development of bioprocess technologies and biological products. Dan Dumbacher, professor of engineering practice in AAE, coordinated the event.

"This was a wonderful opportunity to learn about the results from space exploration research, how these results can apply on Earth, and how the human health sciences and biomedical engineering can help humans live and work on the frontier of space," Dumbacher says.



FROM LEFT / Michael Ladisch, Distinguished Professor of Biomedical Engineering; Bill Gerstenmaier, associate administrator for human exploration and operations for NASA; and Dan Dumbacher, professor of engineering practice in AAE

PURDUE WINS LAUNCH SLOT ON ATLAS V

Purdue researchers working on the Aerodynamic Deorbit Experiment (ADE) have won the opportunity from United Launch Alliance (ULA) to send their experiment on a future Atlas V rocket mission.

Purdue's was one of four student proposals selected by the launch service provider to receive a free CubeSat launch slot. The company's new innovative rideshare program, dubbed CubeCorp, encourages hands-on experience to motivate, educate and develop the next generation of rocket scientists and space entrepreneurs. The ADE project will involve students throughout the flight project life cycle, including design, integration, testing and mission operations.

"ADE represents the first Purdue-developed satellite that will be launched and operated in orbit," says David Spencer, associate professor of aeronautics and astronautics and principal investigator on the project. "Launching a fully functional spacecraft is a big step forward for our astronautics research and educational opportunities."

Purdue's ADE is a small-scale prototype of a bolt-on device that can be used to deorbit 150 kilogram-class satellites from orbit altitudes of up to 1,200 kilometers in fewer than 25 years.

The specific objectives of the ADE mission are to provide flight qualification and characterize the performance of a prototype passive, aerodynamically stable deployable drag device to accelerate the deorbit of CubeSats and small satellites.

The ADE 1U CubeSat (10 cm x 10 cm x 10 cm) will deploy a thin-membrane dragsail with 1-meter-long booms. The geometry of the drag device is designed to be aerodynamically stable and passively trim to a maximum-drag attitude. "The capability of this system to align itself into a maximum drag orientation as it passes through the atmosphere will allow satellites to deorbit more rapidly after the end of their useful missions," Spencer says.

ADE will be deployed from the launch vehicle into a geosynchronous transfer orbit with orbit altitudes ranging from 185 km to 35,756 km. Based on simulations, once the dragsail is deployed, the system should deorbit in about 11 days. ADE will collect acceleration and angular rate data during each pass through the upper reaches of the Earth's atmosphere. The acquired data set will be used to assess the aerodynamic stability of the system.

"Companies and organizations like SpaceX and OneWeb are actively pursuing the

PROFESSOR DAVID SPENCER PART OF NASA-SELECTED TEAM FOR CUBESAT STUDY

Purdue has been selected by NASA, under its Planetary Science Deep SmallSat Studies (PSDS3) program, to conduct a funded concept study for planetary small satellite missions.

Professor David Spencer is part of the Purdue team developing the mission concept, named "Chariot to the Moons of Mars." David Minton, professor of earth, atmospheric, and planetary sciences, is the principal investigator for the

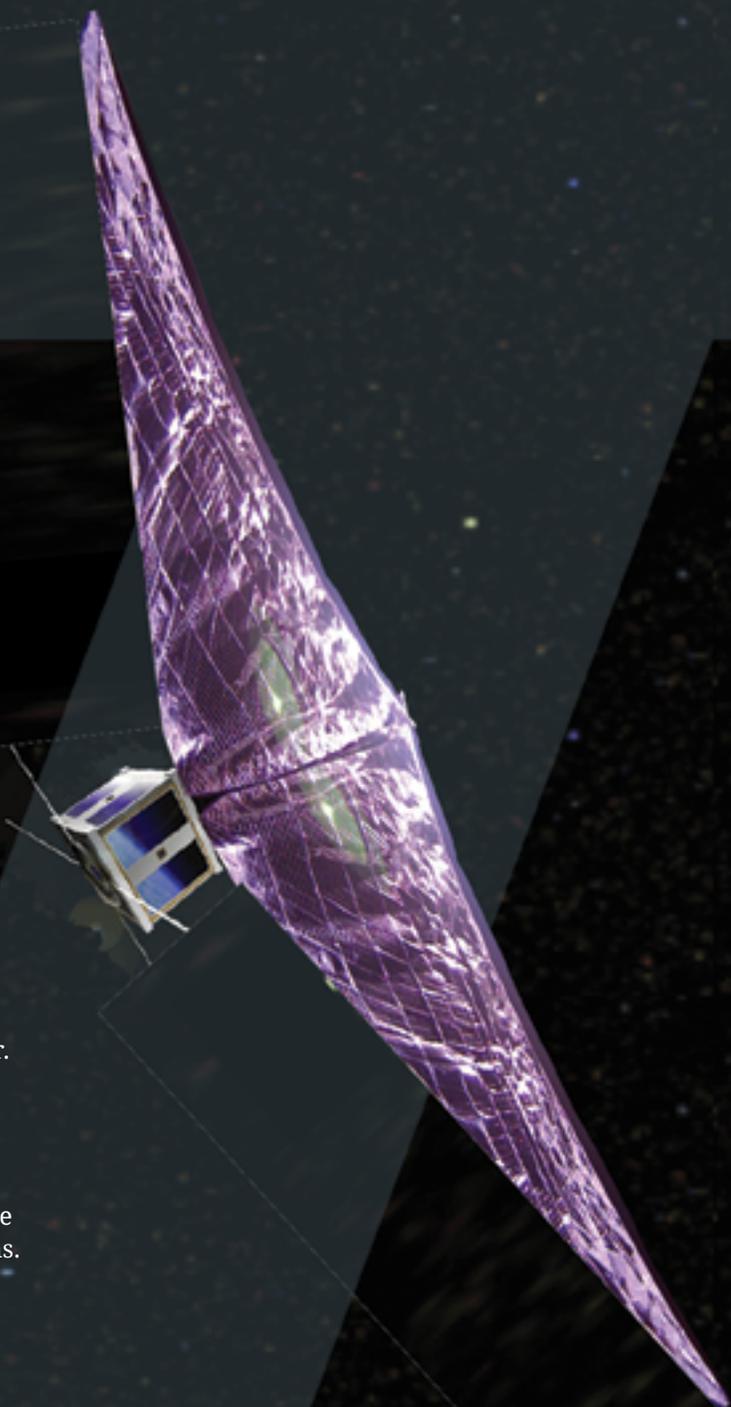
study. The mission uses a 12 unit CubeSat with a deployable drag skirt to produce high resolution imagery and surface material composition of Phobos and Deimos, to help understand how they were formed.

Ten studies were chosen; awards totaled \$3.6 million. The PSDS3 awardees were recognized at the 48th Lunar and Planetary Society Conference in The Woodlands, Texas, on March 20 24.

deployment of thousands of small satellites into this regime for global internet service,” Spencer says. “A successful ADE mission will demonstrate the viability of the drag device, with commercial application relevant to the deorbit of large constellations of satellites.” The research group is targeting a launch date in the second quarter of 2018.

“ULA is passionate about educating and developing future leaders in the space industry,” says Tory Bruno, ULA CEO and president. “We’ve established a very low-cost approach to CubeSat design and launch to accommodate our commitment to STEM and innovative commercial CubeSat entrepreneurs.”

Alina Alexeenko, professor of aeronautics and astronautics at Purdue, is co-principal investigator. Alexandra Long, a PhD candidate from Georgia Tech, is the cognizant engineer for the drag device. Garry Qualls at NASA Langley Research Center has generously offered the use of the LarkWorks MakerSpace facility for prototyping the deployment mechanisms and mechatronic systems. Les Johnson at NASA Marshall Space Flight Center is serving as an advisor to the project. Johnson is currently the PI for the Near Earth Asteroid Scout solar sail.



ALINA ALEXEENKO



DAVID SPENCER



Board of Trustees ratifies **NAMED HEADSHIP FOR SHIH**

The Purdue University Board of Trustees has approved a named headship for the School of Aeronautics and Astronautics. Tom Shih was ratified on Dec. 16, 2016, as the J. William Uhrig and Anastasia Vournas Head of Aeronautics and Astronautics, which was made possible by a generous gift from alumnus J. William Uhrig (BSAAE '82) and Anastasia Vournas. The funding granted to Shih's endowed headship will enable the school to engage in innovative educational and research initiatives. Those initiatives will affect hundreds of students each year in offering a host of unique opportunities.

Shih shared the following vision with the Board of Trustees:

"I am extremely honored by this endowed headship and excited about what it could do for the School of Aeronautics and Astronautics. I want to express my deepest thanks to Bill Uhrig and Anastasia Vournas for their generosity and for wanting to help our school move forward.

"The funding from this endowed headship will enable us to continually enhance the



Tom Shih, the J. William Uhrig and Anastasia Vournas Head and Professor of Aeronautics and Astronautics

excellence in the quality of education that we provide to our students on rigor, depth, critical thinking and problem-solving at both the undergraduate and graduate levels. We want student success to be linked to creating dreams that inspire, making those dreams into reality to show the strength of the human spirit and human ingenuity, and to discovering mysteries of the universe to fulfill our deepest yearnings to understand.

"We want to create a stimulating environment to nurture the next generation of aerospace engineers, visionaries and leaders. As engineers, our job is to make dreams into reality. We are working to create a collaborative and nurturing environment across departments and colleges within Purdue and with our partners in government and the private sector to chart a course to make Purdue's School of Aeronautics and Astronautics a most exciting and dynamic place to learn, grow, discover and make dreams into reality."



TOM VICE

Charles Rolls and Henry Royce MEMORIAL LECTURE

The School of Aeronautics and Astronautics was honored to have Tom Vice give the 2016 Charles Rolls and Henry Royce Memorial Lecture on Sept. 6, 2016. His talk was titled "Future of Advanced Trusted Cognitive Autonomous Systems."

Vice recently retired from his position as the corporate vice president and president of Northrop Grumman's Aerospace Systems sector, a premier provider of manned and unmanned systems, space

systems, missile systems and advanced technologies critical to the nation's security. He currently sits on the Steering Advisory Council for Purdue AAE.

Begun in 2002, the Charles Rolls and Henry Royce Purdue Memorial Lecture Series is presented by Rolls Royce and Purdue AAE. The series brings to campus speakers from the aviation and aerospace industries to inspire students who are considering careers in these fields. The 2016 lecture was the eighth in the series.



ALUMNUS DAVID SPENCER joins AAE faculty

Professor David Spencer joined the AAE faculty in fall 2016 after six years as a professor of practice at Georgia Tech. Before that, Spencer spent 17 years at NASA's Jet Propulsion Laboratory in Pasadena, California, where he was the deputy project manager for the Phoenix Mars Lander, mission manager for the Deep Impact and Mars Odyssey projects, and mission designer for Mars

Pathfinder and TOPEX/Poseidon.

Spencer is an alumnus of the Purdue AAE program, earning BS and MS degrees in 1989 and 1991, respectively. He says the lure of working at his alma mater is only one reason he decided to join the Purdue AAE faculty.



DAVID SPENCER

"Purdue has a very strong program and is extremely well-known in space mission design," he says. "The strong ties between AAE and Purdue's Department of Earth, Atmospheric, and Planetary Sciences is key, as well. I look forward to partnering with them on projects."

Spencer's research interests include small-satellite applications, the orbital mechanics involved in the relative motion of one spacecraft with respect to another, and what he calls aeroassist technologies.

"Aeroassist means using the atmosphere of a planet to help shape the orbit," Spencer says. "There are several different categories of that, including entry, descent and landing, aerocapture and aerobraking."

Spencer earned a PhD from Georgia Tech in 2015. He is an associate fellow in the American Institute of Aeronautics and Astronautics and is the author and co-author of technical publications in the fields of mission design, flight operations and system engineering. Spencer has earned numerous awards and honors, including the Purdue School of Aeronautics and Astronautics' Outstanding Aerospace Engineer Award in 2004.



DOMINICK ANDRISANI



DAVID FILMER

PROFESSORS ANDRISANI, FILMER RETIRE FROM PURDUE AAE

Professor Dominick Andrisani retired after 37 years of service to Purdue AAE. Andrisani had two major areas of research: precision location of ground targets from airborne platforms and air traffic management. He was honored twice with the Elmer F. Bruhn Outstanding Teacher Award, in 2007 and 2013, and he received the W.A. Gustafson Outstanding Teacher Award in 2007.

Professor David Filmer retired after 15 years with Purdue AAE. His technical interests included satellite design and ground station design for acquisition of satellite data. Filmer served on the biological sciences faculty at Purdue for 40 years.

PROFESSOR CHEN RECEIVES HONORARY DOCTORATE



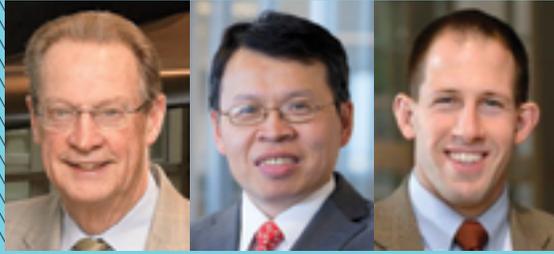
WEINONG CHEN

AAE Professor Weinong "Wayne" Chen has received an honorary doctorate in technology by Tampere University of Technology in Finland.

The title of honorary doctor is the highest recognition that a university can award. The conferment ceremony took place on May 20, 2017. Awardees received a doctoral hat as a symbol of academic freedom and a written conferment certificate.

The university invited 10 individuals from Finland and abroad to accept honorary doctorates in recognition of excellence in fields represented at the university and other exceptional scientific, artistic or social merits.

Chen's honorary doctorate came "in recognition of significant contributions to the research of the behavior of high deformation rates in materials as well as longstanding collaboration in research and technological development in the field of materials science."



R. BYRON PIPES

WENBIN YU

**JOHNATHAN
GOODSELL**

AAE FACULTY HONORED WITH SEED FOR SUCCESS AWARD

More than 150 Purdue faculty and staff gathered in November 2016 for the Excellence in Research Awards dinner, celebrating the accomplishments and contributions of Purdue's research community.

Honorees included R. Byron Pipes, the John L. Bray Distinguished Professor of Engineering, who has a joint appointment in AAE, materials engineering and chemical engineering; AAE Professor Wenbin Yu; and AAE Research Assistant Professor Johnathan Goodsell.

The three received a 2016 Seed for Success award, along with Purdue Polytechnic Professor Ronald Sterkenburg and Purdue Materials Engineering Professor Alejandro Strachan, for their work with the Institute for Advanced Composites Manufacturing Innovation.

Principal investigators and co-investigators garnering an award of \$1 million or more were recognized with the Seed for Success Award.



WILLIAM CROSSLEY

★ ★ ★

Outstanding Faculty Mentor Award

William Crossley is the recipient of the 2017 Outstanding Faculty Mentor Award, as voted on by graduate students in the School of Aeronautics and Astronautics. Eleven faculty members were nominated by AAE graduate students, and representatives from Aero Assist, AAE's graduate student organization, chose Crossley as the winner.

The nomination for Crossley, in part, read, "This award recognizes Professor William Crossley for exemplary mentorship of graduate students, particularly for his humility and patience: no subject is too banal, no question too trivial, no opinion too petty and no plan too futile. His pragmatic, unbiased approach

helps students discover the true substance and worth in their ideas, and themselves, especially when they cannot. We feel honored to have him as an advisor."

Crossley received the 2017 Outstanding Faculty Mentor Award during a gathering on April 27 at Neil Armstrong Hall of Engineering.

FACULTY

AWARDS

AND

HONORS



INSEOK HWANG

★ ★ ★

University Faculty Scholar

Professor Inseok Hwang has been named a University Faculty Scholar. The University Faculty Scholar program was created at Purdue in 1998. Recipients of this honor are tenured associate professors and full professors who have been in that rank for no more than five years and are named in recognition of their scholarship.

Hwang has been a professor in the School of Aeronautics and Astronautics since 2004 and is head of the Flight Dynamics and Control/Hybrid Systems Laboratory. The research in the FD&C/HS Lab focuses on modeling and control of the Cyber Physical System, which is a complex (networked) system with interacting physical and logical components, and its applications to safety critical aerospace systems such as aircraft, spacecraft, unmanned aircraft systems (UAS), air traffic control and multiple vehicle systems, such as a swarm of UAS.

University Faculty Scholars are nominated by their academic areas, reviewed by a committee of distinguished and named professors in the College of Engineering that makes a recommendation to the dean, and approved by the provost. They receive funding to support their research. The newly named University Faculty Scholars are beginning their five year terms this fall.



MICHAEL SANGID

★ ★ ★

NSF Early Career Development Award

Michael Sangid, the Elmer F. Bruhn Assistant Professor of Aeronautics and Astronautics, has won a 2017 Faculty Early Career Development award from the National Science Foundation. The CAREER award is one of the most prestigious NSF honors for outstanding young researchers.

Sangid is principal investigator on a project studying residual stresses on polycrystalline materials. Materials such as metals, alloys and ceramics dominate the infrastructure of modern society in terms of both tons of raw material usage and in the breadth of applications, which span energy, transportation, defense and other sectors. Stresses introduced during the processing of these materials, known as residual stresses, are present in all materials and can have tremendous effects on performance. The research will lead to the development of a computational framework to account for residual stresses and faithfully predict their distributions.

The results will explain the role of residual stresses across length scales in polycrystalline materials. Ultimately, the research will develop more accurate lifetime predictions of the alloys and fabricate tailored components that offer either minimal or beneficial residual stresses and therefore are more resistant to failures.



VIKAS TOMAR

★ ★ ★

C.T. Sun Award

Professor Vikas Tomar was the recipient of the 2017 C.T. Sun School of Aeronautics and Astronautics Excellence in Research Award. The honor is presented annually to an individual or a team of faculty members in Purdue's School of Aeronautics and Astronautics to

recognize high-quality contributions in science and engineering.

Tomar is a member of AAE's Structures and Materials group. His research has led to a new paradigm in material testing through the development of a new Purdue patented analytical technique called Nanomechanical Raman Spectroscopy (NRS). Tomar's work has been recognized by a number of awards. These include the Young Investigator award for high temperature interface thermomechanics from the Air Force Office of Scientific Research; the Orr Early Career Award for Excellence in fracture and fatigue from the American Society of Mechanical Engineers; the Early Career Faculty Fellow-Honorable Mention Award for materials research from the Minerals, Metals and Materials Society; and the Young Researcher Award for interface mechanics from the inaugural Elsevier Materials Science and Engineering journal. Tomar was elected an Associate Fellow of the American Institute of Aeronautics and Astronautics in 2015 and a Fellow of the American Society of Mechanical Engineers in 2016.



CONTINUED ON NEXT PAGE →

HIGH VELOCITY

FACULTY NEWS



MICHAEL GRANT

★ ★ ★

W.A. Gustafson Award for Outstanding Teaching • Nominee for Purdue Exceptional Early Career Teaching Award

Assistant Professor Michael Grant is the winner of the prestigious 2016 W.A. Gustafson Award for Outstanding Teaching, and he has been selected as the College of Engineering's nominee for Purdue's Exceptional Early Career Teaching Award.

The recipient of the Gustafson award is selected by the juniors and seniors of the AAE student body. It is made possible by the interest and generosity of friends and alumni of the school.

"Though AAE is at a world class research university, excellence in teaching has always gone hand in hand with excellence in research," says Tom Shih, the J. William Uhrig and Anastasia Vournas Head of Aeronautics and Astronautics. "With so many outstanding educators in AAE, it is quite a feat for Professor Grant to be chosen for this award."

Grant is a Purdue alumnus (BSAAE '05). He joined the AAE faculty in 2012 after earning an MSAAE and PhD in AAE from Georgia Institute of Technology.

Three additional faculty members were also nominated for the W.A. Gustafson Award for Outstanding Teaching: Karen Marais, Tyler Tallman and James Longuski.

The purpose of the Exceptional Early Career Teaching Award is to honor assistant professors with two or more years of service who have established an early record of exceptional teaching. Nominees are judged based on instructional effectiveness, course instruction improvement and innovation, contact with students outside the classroom, service as a research mentor for undergraduate students outside of normal classroom activity, and participation in college/school or university committees related to undergraduate education.

"Purdue established the Exceptional Early Career Teaching Award in 2014 to recognize assistant professors who are outstanding undergraduate teachers," says Kathleen Howell, associate dean for engineering and the Hsu Lo Distinguished Professor of Aeronautics and Astronautics. "These faculty demonstrate superior ability in communicating material to students and stimulate their desire to learn. Outstanding teachers also recognize that their teaching responsibility to students does not stop at the classroom door. I cannot think of anyone who exemplifies this philosophy better than Mike Grant."

Grant's nomination was presented to the University selection committee on Feb. 27, 2017, and he was recognized as the recipient of the College of Engineering's Exceptional Early Career Teaching Award at the college's Faculty Awards of Excellence Banquet on April 7.



FACULTY AWARDS AND HONORS

CONTINUED



TIMOTHÉE POURPOINT

★ ★ ★

AIAA Associate Fellow

AAE Associate Professor Timothée Pourpoint has been selected as an Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA). Pourpoint was inducted with other new associate fellows from around the world at a ceremony on Jan. 9, 2017, during the AIAA SciTech Forum in Grapevine, Texas.

AIAA is the world's largest technical society dedicated to the global aerospace profession, with more than 35,000 individual members worldwide and nearly 100 corporate members. AIAA brings together industry, academia, and government to advance engineering and science in aviation, space and defense. Pourpoint's research interests relate to propulsion, combustion and energy storage.

According to the AIAA, associate fellows are "individuals of distinction who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics or astronautics."

To be selected as an associate fellow, an individual must be an AIAA senior member with at least 12 years' professional experience and be recommended by a minimum of three current associate fellows. Only 2 percent of the AIAA's 35,000-plus members are elected as associate fellows each year.



KATHLEEN HOWELL

★ ★ ★

National Academy of Engineering • American Academy of Arts and Sciences • Bruhn Award

Kathleen C. Howell, the Hsu Lo Distinguished Professor of Aeronautics and Astronautics and associate dean for engineering, has been elected to the prestigious National Academy of Engineering. Howell is among 84 new members and 22 new foreign members of the academy.

"It's a big honor for me to be elected to the NAE," Howell says. "It's particularly notable to be elected by your colleagues. I'm grateful to other NAE members at Purdue that I now have the honor of joining."

Election to the NAE is among the highest professional honors for an engineer. Academy membership honors those who have made outstanding contributions to engineering research, practice or education.

Howell was elected to the NAE "for contributions in dynamical systems theory and invariant manifolds culminating in optimal interplanetary trajectories and the Interplanetary Superhighway."

"We are extremely proud of Professor Howell for her significant contributions that led to this recognition," says Tom Shih, the J. William Uhrig and Anastasia Vournas Head of Aeronautics and Astronautics. "Since being elected to the National Academy of Engineering is one of the highest distinctions an engineer can receive, Professor Howell's accomplishments bring honor not just to her, but also to AAE, our college and our great University."

2017 was a big year for Howell. In addition to her election to the NAE, Howell was elected to the American Academy of Arts and Sciences, one of the nation's oldest and most prestigious honorary societies. Founded in 1780, the AAAS is an independent research center that conducts multidisciplinary studies of complex and emerging problems. Howell joins 11 Purdue colleagues as members of the AAAS.

"Receiving one of these honors in your area is unbelievable," Howell says. "Having both — and at almost the same time — is almost miraculous. I look forward to representing Purdue in these organizations."

"Dr. Howell's work on spacecraft trajectories and interplanetary travel is a testament to the strides Purdue is making toward the future every day," University President Mitch Daniels says. "She exemplifies the brilliant minds hard at work to make Purdue a greater university and the world a better place."

In addition to these prestigious national honors, Howell has been selected to receive the School of Aeronautics and Astronautics' Elmer F. Bruhn Award for 2017.

The Bruhn award is presented annually to an outstanding teacher in the School of Aeronautics and Astronautics and is made possible by the generosity of friends and alumni of the school. The winner is selected by the AAE undergraduate student body. Howell previously won the award in 1984, 1987, 1990, 1995, 2002, 2005 and 2010.

Howell has taught aeronautics and astronautics at Purdue since 1982. She is an expert on spacecraft navigation and orbital mechanics and the motion of man made objects in space. Howell has designed novel trajectories for spacecraft that have enabled some space missions, and she was largely responsible for the design of the intricate series of Cassini spacecraft maneuvers that contributed to the success of the ongoing exploration of Saturn and its moons. She has developed techniques that help reduce the cost in fuel and design time for planetary missions with spaceships in orbits near points in the solar system where satellites can be safely placed.

A NEW ERA OF SPACE EXPLORATION

Dumbacher co-chairs committee reviewing NRC decadal survey report

Dan Dumbacher, professor of engineering practice, is co-chairing a committee to review NASA's progress in addressing the strategies, goals and priorities outlined in the 2011 National Research Council decadal survey report, "Recapturing a Future for Space Exploration, Life and Physical Sciences Research for a New Era."



DAN DUMBACHER

Dumbacher is co-chairing the "Midterm Assessment of Implementation of the Decadal Survey on Life and Physical Sciences Research at NASA" ad hoc committee for the National Academies of Sciences, Engineering, and Medicine. The committee is charged with reviewing the "highest priority recommendations" in the decadal survey and identifying and ranking a set of

priorities that are critical for NASA to enable the expansion of human exploration into deep space. The committee also will recommend the environment where research should take place to be successful, such as Earth analogs, low Earth orbit (on the International Space Station through 2024), low Earth orbit (on other platforms) and beyond Earth orbit (such as a cis-lunar habitat).

"Life and physical science research is essential to assuring a healthy space traveler," Dumbacher says. "With this National Academies activity, Purdue has the opportunity to be visibly involved in the planning and assessment so essential for long-term, sustainable space exploration."

The report will be delivered to NASA by the end of 2017, Dumbacher says, and there will be a public press briefing about the report.

Collicott appointed to Committee on BIOLOGICAL AND PHYSICAL SCIENCES IN SPACE

AAE Professor Steven Collicott has been appointed to the Committee on Biological and Physical Sciences in Space. The group is a standing committee of the National Academies of Sciences, Engineering, and Medicine.

Reporting to the Space Studies Board, the



STEVEN COLLICOTT

CBPSS aims to support scientific progress in space research in the biological, medical, and physical sciences, and to assist the federal government in integrating and planning programs in these fields.

2 FACULTY PROMOTED TO FULL PROFESSOR

Two faculty members have been promoted to full professor. The promotions of James L. Garrison and Wenbin Yu were approved by the Purdue University Board of Trustees at a meeting April 21. The promotions were effective starting with the 2017-18 academic year.



JAMES L. GARRISON



WENBIN YU

SUPER SPEED

**Purdue Hyperloop in 2017 summer competition
after strong winter showing in Hawthorne, California**



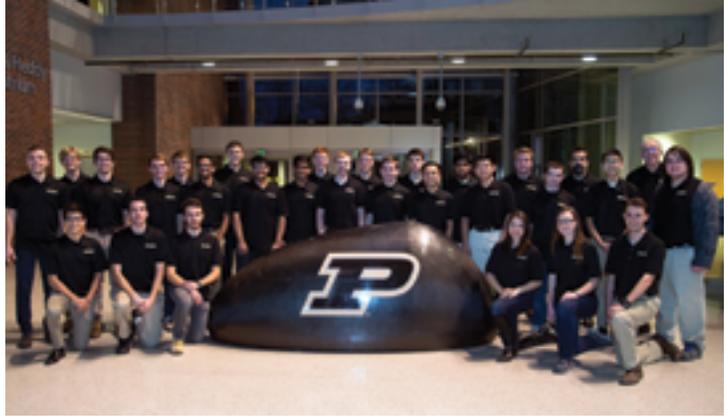
The Purdue Hyperloop team spent the spring semester refining its pod in preparation for a second competition in the summer of 2017. The team made a solid showing in 2016 at the first Hyperloop competition hosted by SpaceX at its headquarters in Hawthorne, California. Company CEO and founder Elon Musk proposed Hyperloop as a mode of high-speed transportation that would propel passengers or cargo in a pod-like vehicle through a near-vacuum tube.

The Purdue Hyperloop project began as a design class in fall 2015, with Professor Alina Alexeenko teaching the class and advising the team. Professor John Sullivan also helped advise the team in the design process. For the 2016-17 academic year, mechanical engineering Professor Guillermo Paniagua advised the team.

The Purdue team was one of 27 teams that traveled to California to test their pods in January — but was one of only seven teams whose pods met the stringent requirements to be tested on the three-quarter-mile track SpaceX built for the competition. Richard Brookes, Purdue Hyperloop project manager and AAE student, says that in order to be cleared for a run on the test track, teams had to prove their pods could fit in the tube and that their braking systems worked.

Brookes says even though there wasn't enough time during the competition weekend for Purdue to test its pod under full race conditions, he is happy with the team's performance overall.

"As with any big project, you're rushing to get



ABOVE / The Purdue Hyperloop team poses with its pod in the Kurz Atrium of the Neil Armstrong Hall of Engineering. **AT LEFT** / Purdue Hyperloop pod inside the test track at the Hyperloop competition hosted by SpaceX at its headquarters in Hawthorne, California.

a few things done," Brookes says. "We were right down to the wire trying to get everything to work. Then, just at the start of the competition, everything came together really nicely. Everything on the pod was functioning just as we wanted it to."

In addition to seeing their pod work, Brookes says one of the best parts of the weekend was interacting with Elon Musk.

"He came over, looked at our pod and complimented the sleek design," Brookes says. "We got compliments from Musk and a lot of SpaceX people about the quality of our composites work. Purdue does excellent composites work, and we were the only fully composites pod in the competition."

The team analyzed the data gathered from the pod's run on the test track and used it to make improvements for the summer 2017 competition, once again hosted by SpaceX. The winners of Hyperloop Competition II will be determined based on a single criterion: maximum speed.

PURDUE AWARDS FROM HYPERLOOP I COMPETITION

#7 

DESIGN AND CONSTRUCTION

HONORABLE MENTION 

PERFORMANCE AND OPERATIONS



Three AAE students win

20 TWENTIES AWARDS



Three AAE students are recipients of Aviation Week’s prestigious “20 Twenties” award for 2017. Geoffrey Andrew, Julia Crowley Farenga and Emily Zimovan were chosen from an international field of candidates. Final selection was based on exceptional academic performance, communication skills and student contributions to the broader community. The recipients were honored in March at Aviation Week’s Laureates Awards, where they had the opportunity to connect with some of the foremost innovators and leaders in the aerospace industry.

About EMILY ZIMOVAN

Zimovan, a master’s student of Professor Kathleen Howell, plans to pursue her PhD. Her research focuses on orbits near the moon, specifically near rectilinear halo orbits, for

a future manned habitat. Zimovan says being named one of the 20 Twenties is an honor.

“To be recognized among my peers as one of the top students in the field is really cool!” she says. “It gives me confidence that I’m in the right field and that the work I’ve been doing thus far is important.”

About GEOFFREY ANDREWS

Andrews is a PhD student of Professor William Anderson. His research focuses on computational modeling of combined-cycle rocket engines for launch vehicles. Andrews says he was genuinely surprised to be chosen as one of the 20 Twenties.

“As a graduate student, I find that it’s easy to develop a case of tunnel vision focusing on coursework and research,” he says. “To be recognized in this way is a humbling reminder of what it means to be a member of the broader aerospace community.”

About JULIA CROWLEY FARENGA

Farenga is in her first year of the PhD program with Professor William Anderson. Her research focuses on combustion stability of supercritical temperature and pressure dodecane and oxygen in rocket engines. She says she is honored to be named one of the 20 Twenties.

“The award means to me that my academic, extracurricular and outreach efforts have been worthwhile,” she says. “Being included with the other amazing winners is an inspiration to reach higher.”



PICTURED FROM LEFT / AAE students and 20 Twenties Award winners Emily Zimovan, Geoffrey Andrews, and Julia Crowley Farenga

DEFYING GRAVITY

Undergrads test NASA equipment in Micro-g NExT program

A team of AAE undergraduate students was selected by NASA to test its spaceflight hardware design in NASA's Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) program. Micro-g NExT provides undergrads an opportunity to design, build and test a tool or device that addresses a space exploration problem. The team, students in Professor Steven Collicott's AAE 41800: Zero-gravity Flight Experiment class, submitted its original proposal for a tool to anchor an astronaut to the surface of an asteroid.

"Being smaller than planets, asteroids have much weaker gravitational force attracting the astronauts to the surface of the asteroid," Collicott says. "A way to tether an astronaut or an instrument to the surface is needed. This is the team's goal."

Students have now built and tested their design, under the advisement of David Wolf, visiting professor and Purdue alumni astronaut. In May, the student team worked with NASA astronauts and engineers



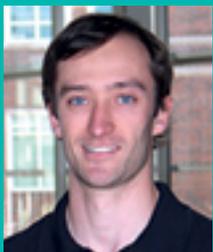
FROM LEFT / Cameron McInnes, Cody Myers (team leader), Sarah Bugelhoff, Katie Bugelhoff and Nikhil Gupta

to test their design in NASA's Neutral Buoyancy Lab, a massive swimming pool in which astronauts train for spacewalks and test spaceflight hardware. Professional NBL divers will test the tool while the student team directs them from the Test Conductor Room of the NBL facility.

The Purdue AAE 41800 class has produced winning proposals for all three years of the NASA NExT program. This win also continues a long series of successful undergraduate proposals for zero-gravity projects from AAE 41800 that began in fall 1996.



GOGGIN WINS CHARLES C. CHAPPELLE FELLOWSHIP



MCCLAIN GOGGIN

AAE 2017 graduate McClain Goggin is a recipient of a Charles C. Chappelle Fellowship for the 2017-18 academic year. The Chappelle Fellowship is a highly competitive and prestigious award that encourages Purdue alumni to pursue graduate research at Purdue. Chappelle fellows are selected on the basis of character, intellectual ability and promise of degree attainment.

Goggin says it is an honor to receive the fellowship.

"I am forever grateful to all of those who have supported me over the last four years," he says. "Especially the other incredibly talented and hardworking students, faculty and staff in Purdue AAE who have had such a huge impact on my life."

Goggin earned his BSAE in May and will pursue his MSAAE at Purdue working with Professor David Spencer in the Space Flight Projects Laboratory. He has just completed his undergraduate research on automated proximity operations for Mars Sample Return under a contract with the Jet Propulsion Laboratory.



AAE holds GRADUATE RESEARCH SYMPOSIUM

AAE held its third annual Graduate Research Symposium on Sept. 27, 2016. The symposium showcased the school's latest research. All PhD students who planned to graduate in 2017 presented talks on their dissertation research, and a portion of AAE's 100-plus MS students presented posters on their thesis research.

The event was held in conjunction with the fall meeting of AAE's Industrial Advisory Council, and the winners were chosen by IAC members. Here are the categories, winners and professors who served as advisors:

- Aerodynamics oral presentation: Harshad Lalit (Haifeng Wang and Jay Gore).
- Astrodynamics oral presentation: Wayne Schlei (Kathleen Howell and Xavier Tricoche).
- Dynamics and control oral presentation: Jacob Haderlie (William Crossley).
- Propulsion oral presentation: David Stechmann (Stephen Heister).
- Structures oral presentation: Andrea Rovinelli (Michael Sangid).
- Morning poster session: Brandon Sells (Daniel DeLaurentis and William Crossley).
- Afternoon poster session: Nyansafo Aye-Addo (Nicole Key).

ABOVE, FROM LEFT / Tom Shih, Jacob Haderlie, Nyansafo Aye-Addo, Brandon Sells, Harshad Lalit and David Stechmann



Students win BROOKE OWENS FELLOWSHIP, PAID INTERNSHIPS

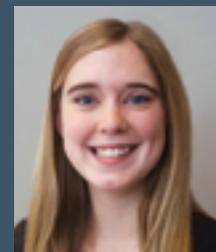
Two AAE undergrads received paid summer internships under the Brooke Owens Fellowship Program. Amy Comeau and Ana Paula Pineda Bosque were two of approximately 30 women selected from across the country. Both students were recommended for the program by Sarag Saikia, AAE visiting assistant professor.

The program was established to honor the legacy of Dawn Brooke Owens (1980-2016), a space industry pioneer and accomplished pilot, who died in 2016 at the age of 35 after a long battle with cancer. The fellowships offered through the program are open to women seeking an undergraduate degree in any field, as long as they intend to pursue a full-time career related to aviation or aerospace.

Comeau spent the summer working for The Tauri Group Space and Technology LLC, while Pineda Bosque worked for Orbital ATK.

Along with a paid summer internship, the program provides two mentors for each fellow — an on-site mentor at their internship host institution, plus a second mentor working elsewhere in the industry. Each fellow also attends the annual "Brooke Owens Fellowship Conference," co-located with the Future Space Leaders Conference.

BELOW, FROM LEFT / Anna Paula Pineda Bosque and Amy Comeau





AAE PhD student appointed SPACE GENERATION CONGRESS 2017 CONGRESS MANAGER



AAE PhD student Arnau Pons served as congress manager of the Space Generation Congress (SGC) 2017. Pons is researching combustion instabilities in aerospace propulsion

ARNAU PONS

systems at Purdue's Maurice J. Zucrow Laboratories under the guidance of Professor William Anderson. As congress manager, he led a team of international students and young professionals in organizing SGC 2017, which was held Sept. 21-23 at the University of Adelaide (Australia).

The SGC is the annual meeting of the Space Generation Advisory Council (SGAC) held in conjunction with the International Astronautical Congress. Participants include top university students and young professionals from government, industry and academia. The congress attracts more than 130 delegates from over 30 countries to outline solutions for today's biggest space challenges. The SGAC is a nonprofit organization with a permanent observer status with the United Nations Committee on the Peaceful Uses of Outer Space. The SGAC is supported by international space agencies such as NASA, ESA and JAXA and by aerospace companies.



FROM LEFT / Julia Crowley Farenga, Eric Westphal, Michael Baier and Monique McClain

AAE students win NSF, NASA FELLOWSHIPS

AAE graduate students Julia Crowley Farenga and Eric Westphal are among the honorees of the 2017 National Science Foundation Graduate Research Fellowship Program. GRFP provides three years of financial support within a five-year fellowship period for graduate study that leads to a research-based master's or doctoral degree.

Crowley Farenga is a student of William Anderson, AAE professor and associate head.

"I feel gratified that my proposal for research into the combustion stability of transcritical and supercritical fuels in rocket engines was recognized as an important and worthwhile subject," Crowley Farenga says.

Westphal is a student of Steven Son, professor of mechanical engineering and AAE courtesy professor. In addition to the NSF fellowship, Westphal garnered a NASA Space Technology Research Fellowship.

"I look forward to furthering my academic career and contributing to the scientific community with the funding and opportunities provided by one of these fellowships," Westphal says.

AAE students Michael Baier and Monique McClain also each captured a NASA Space Technology Research Fellowship. They are both students of Son.

Baier says the fellowship will give him the freedom to pursue potentially groundbreaking research related to rocket propulsion.

McClain says she is excited to see how her research progresses and how she will grow professionally throughout the duration of the program.

The NASA fellowships are given to graduate students who show significant potential in the creation of innovative space technologies for the nation's exploration and economic future. Each student is matched with a technically relevant and community-engaged researcher, usually at a NASA center, who serves as a professional research collaborator.





PURDUE'S MARS SOCIETY TAKES THIRD PLACE at International Gemini Mars Design Competition

A group of Purdue AAE students won third place in the International Gemini Mars Design Competition. The final round of the contest was held in September at the 2016 International Mars Society Convention in Washington, D.C.

Initiated by the Mars Society in August 2015, the Gemini Mars competition invited engineering students from around the world to create a detailed plan for a two-person Mars flyby mission.

Nineteen teams entered the competition. Of those, 10 teams representing more than 20 universities from seven countries were selected to participate in the final round. The finalists presented their design proposals in person at the annual Mars Society convention before a group of seven judges representing NASA, the aerospace industry and the Mars Society.

Students from the Mars Society Purdue Chapter made up Team Itinere, which placed third overall. The team was the only one from the United States to finish in the top five.

ABOVE, FROM LEFT / Alek Gardner, Glynn Smith, Michael Weiss, Diego Martinez, Maanee Gupta, Eric Schweitzer, Surya Vezhavendan, Eiji Shibata and Robert Potter. Not pictured: Arnau Pons.

GRADUATE STUDENTS WIN MAGOON AWARDS AND HONORS for outstanding service, research

Five AAE graduate students received 2017 Magoon Excellence in Teaching Awards from the College of Engineering. The honor recognizes students who were exemplary teaching assistants:

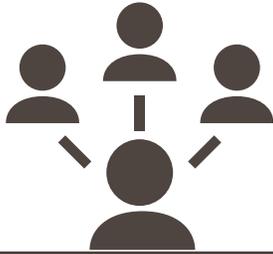
- Sayan Biswas (Advisor Li Qiao)
- Ashwati Das (Advisor Kathleen Howell)
- Katherine Fowee (Advisor Alina Alexeenko)
- Brandon Sells (Advisors William Crossley and Daniel DeLaurentis)
- Waterloo Tsutsui (Advisor Wayne Chen)

Graduate student Samantha Alberts received the 2017 Outstanding Service Scholarship. The scholarship is presented to engineering graduate students who have provided outstanding service to the graduate student community, their school, the college and/or the University. Alberts is a student of Professor Steven Collicott.

Chao Han is the 2017 recipient of the Award for Outstanding Research, which goes to students who have demonstrated excellence and leadership in research through publications, participation in professional organizations and willingness to mentor others. Han is a student of Professor Haifeng Wang.

BELOW, FROM LEFT / Brandon Sells, Katherine Fowee, Sayan Biswas, Ashwati Das, Waterloo Tsutsui, Chao Han and Professor Wayne Chen





AAE PhD students receive 2017 FELLOWSHIPS

PhD candidates Jayaprakash Suraj Nandiganahalli and Shourya Jain have obtained fellowships for 2017-18.



Nandiganahalli received the Hugh W. and Edna M. Donnan Fellowship. He is a student of Inseok Hwang. Nandiganahalli says he is grateful for the support from Hwang, the College of Engineering and AAE.



“In addition to the generous financial assistance, the fellowship is a recognition that my PhD research on the design of self-aware and resilient control for networked cyber physical systems is important,” Nandiganahalli says.

FROM TOP /
Jayaprakash Suraj
Nandiganahalli,
Shourya Jain

“This award boosts my confidence to further advance my research and focus on completion of my graduate studies.”

Jain is the recipient of the Bilslund Dissertation Fellowship Award. He is a student of Professor Li Qiao.

“I feel honored to have received the prestigious Bilslund Dissertation Fellowship,” Jain says. “I want to give a special thank-you to my advisor, Professor Li Qiao, for her consistent guidance and inspiration.” Both fellowships are awarded to outstanding PhD candidates by Purdue’s College of Engineering. They are highly competitive and recognize superior academic abilities and scholarly achievements.



FROM LEFT / Samantha Alberts, Praveen Srikanth

Graduate students win BEST STUDENT PAPER AWARD

Two AAE graduate students won a Best Student Paper Award from the American Institute of Aeronautics and Astronautics, which was awarded by the Institute's Aerospace Power Systems Technical Committee.

Samantha Alberts was the lead author on the technical paper titled “Experiment Design for Measuring Accommodation Coefficients for Modeling of Long-Duration Spaceflight Cryogenic Propellants.” Praveen Srikanth was the co-author. Both are students of Professor Steven Collicott, who served as advisor on the paper with Professor Stephen Heister.

Alberts says she is honored to receive the recognition. The paper focused on the initial CFD and experiment design work for measuring evaporation and condensation rates of rocket propellant.

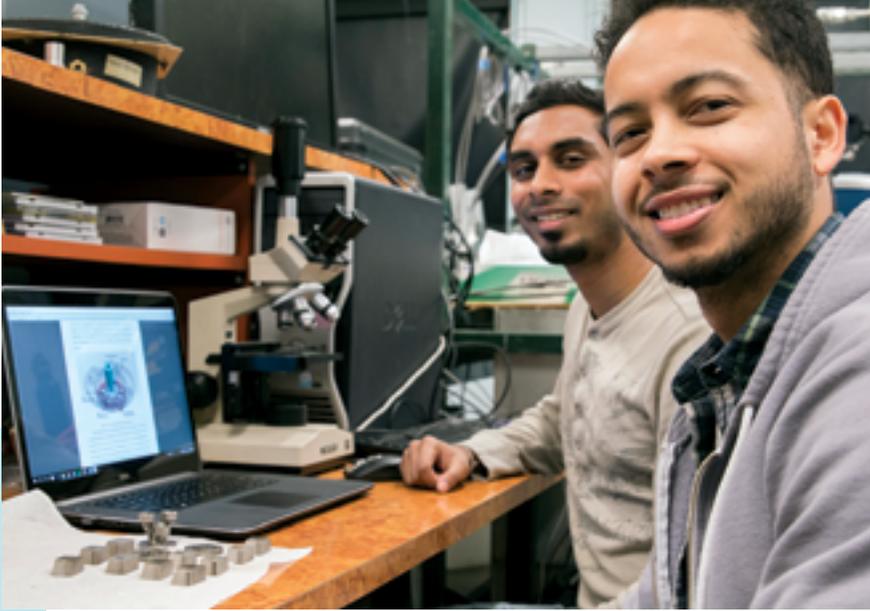
“Accurate measurement of these rates will allow for more efficient storage of cryogenic propellants for long-duration and deep space missions,” Alberts says.

Srikanth says he is grateful to Collicott and everyone who guided him and Alberts in this achievement.

“It is an amazing feeling to be recognized for your work, especially as a graduate student, as it gives you confidence that you are on the right path,” Srikanth says.

A certificate of merit was presented at the AIAA Propulsion and Energy Forum and Exposition in July in Atlanta, Georgia.





Tri-D Dynamics LLC co-founders Deepak Atyam (left) and Alexander Finch work with components and a diagram of one of their engines. They want to produce tomorrow's rocket engines using 3-D printers. PURDUE RESEARCH FOUNDATION PHOTO: OREN DARLING

Until recently, SmallSats have been launched as secondary payloads on larger launch vehicles. But several companies around the world are developing new launch vehicles for smallsats.

Tri-D Dynamics' plan is for the launch vehicles to employ clusters of their engines positioned on the vehicle to lift the payload. The more engines used, the larger the payload capacity.

Tri-D Dynamics officials want to be able to scale up production of engines to allow more launches over shorter time frames.

"Our goal is to see these rockets launching once or twice a week. And that's a minimum of 10 to 20 engines per week when you get to that scale," Atyam says. "Nobody right now can stamp out engines at that rate."

The duo went through Purdue Foundry's LaunchBox program during the fall 2016 semester and continued working with the accelerator in the spring with entrepreneur-in-residence Mike Shepard. Purdue Foundry is an entrepreneurship and commercialization accelerator.

"The Foundry also led us to become involved with Silicon

Valley Boilermaker Innovation Group," Finch says. "They serve as a sort of a proxy board of advisors for us."

SV BIG is a group of Silicon Valley Purdue alumni dedicated to assisting new ventures in the Purdue community. Purdue Foundry suggests that relevant startups pitch their ideas to SV BIG, which then decides what startups to assist.

"We didn't see anything like SV BIG as undergrads in California," Finch says. "To have a dedicated alumni group of entrepreneurs in Silicon Valley dedicated to helping companies from that university is a wonderful asset."

Tri-D Dynamics' founders are working on proving the viability of their idea and looking for investors as well as funding from the U.S. government.

"We hope to gain a large market share of the rocket engine production industry. Most others produce them through conventional methods or outsource them to machine shops," Atyam says. "We want to be the one-stop shop to be able to create rocket engines on a large or small scale."

For more information about Tri-D Dynamics, visit triddynamics.com.

AAE ALUMNUS PROVIDES COMMITMENT TO PAVE THE WAY

Purdue AAE alumnus Bob Truitt (BSAAE '62) and his wife, Patti (MAHSSE '63), have made the initial commitment to Pave the Way, a new philanthropic component to Purdue University's Back a Boiler income share agreement initiative.

Beginning with fall 2017, students who take part in Back a Boiler — designed to offer students and their families an alternative financing option — also may apply for support from the Pave the Way program.

"Our hope is that we can not only help students finance their education, but also help teach the importance of charitable giving, including the joy and importance of giving back to Purdue," Bob Truitt says.

Back a Boiler participants receive education funding in exchange for an agreed-upon percentage of their post-graduation income over a set number of months. In addition to signing a Back a Boiler contract, Pave the Way participants are asked to make a voluntary pledge. After graduation, students fulfill their Back a Boiler commitment and are encouraged to donate to Purdue through charitable giving, creating an evergreen Pave the Way fund to benefit future students.

"It's what we like to call a virtuous cycle," says Amy Noah, vice president for development at the Purdue Research Foundation. "We're grateful to Bob and Patti for establishing an ongoing legacy of philanthropy, and we're hopeful that our generous alumni and friends will be interested in supporting future generations of Boilermakers through this new way of giving to Purdue."



FROM LEFT / Purdue President Mitch Daniels with Patti and Bob Truitt



ABOVE, FROM LEFT / Air Control Officer Lt. Nydia Williams (left), Radar Operator Lt. j.g. Ashley Ellison, Plane Commander Lt. Cmdr. Tara Refo, Pilot Lt. Ashley (Ruic) Faires, and Mission Commander Lt. Cmdr. Brandy Jackson, all assigned to Carrier Airborne Early Warning Squadron (VAW) 125, pose for a photo before flying the first all-female-crewed combat mission in an E-2C Hawkeye aboard the Nimitz-class aircraft carrier USS Carl Vinson (CVN 70). Carl Vinson and Carrier Air Wing (CVW) 17 are deployed to the U.S. 5th Fleet area of responsibility.

PHOTO: U.S. NAVY, JAMES R. EVANS, MASS COMMUNICATION SPECIALIST 2ND CLASS

ASHLEY FAIRES WINS YOUNG ENGINEERING ALUMNUS AWARD

AAE alumna Ashley (Ruic) Faires (BSAAE '06) is the winner of the 2016 Purdue Engineering Alumni Association's Young Engineering Alumnus Award, which is given to a graduate of Purdue's College of Engineering age 35 or younger who has achieved significant rapid advancement in his or her chosen field.

Faires is currently a lieutenant commander in the United States Navy. She serves as an instructor pilot in the carrier-based E-2C Hawkeye and the E-2D Advanced Hawkeye aircraft and is tasked with assuring quality instruction throughout the Navy's E-2C/D fleet. During her second deployment with the fleet, Faires piloted the first all-female combat mission of an E-2C aircraft for the U.S. Navy.

At Purdue, Faires interned with Rolls-Royce in Indianapolis, was in the Navy ROTC program and participated in AAE 418 "Zero-gravity Flight Experiment" class. Professor Steven Collicott, who teaches AAE 418, nominated her for the EAA Young Engineering Alumnus Award.

"I felt like such an average student until I was in Professor Collicott's Zero-gravity Flight Experiment class," she says. "Then I really got involved in doing the design, build and test and that really helped me grow as an engineer and helped shape the rest of my career. I feel like everything started at Purdue."

Faires received the award at a ceremony on Sept. 9, 2016.

Mike Moses promoted to PRESIDENT OF VIRGIN GALACTIC



MIKE MOSES

Purdue AAE alumnus Mike Moses (MSAAE '95) is the new president of Virgin Galactic. Moses joined the company in 2011 as vice president of operations. Prior to that, he worked for NASA, serving as a flight controller, flight director and the shuttle launch integration manager.

Virgin Galactic made the announcement Oct. 13, 2016, at the International Symposium for Personal and Commercial Spaceflight in Las Cruces, New Mexico. Speaking at the event, Moses said, "I've been very fortunate in my career to play a part in safely sending many NASA astronauts to space. At Virgin Galactic, with our great vehicles and our fantastic team, I know

we'll get the chance to send not just tens but hundreds of thousands of people into space."

Virgin Galactic's vehicles include the reusable SpaceShipTwo and its air launch carrier vehicle WhiteKnightTwo.

In addition to his AAE degree from Purdue, Moses earned a bachelor's degree in physics from Purdue in 1989. He received the Outstanding Aerospace Engineer Award from the School of Aeronautics and Astronautics in 2011 and the Distinguished Science Alumni Award from the College of Science in 2016. Moses also is a two-time recipient of the NASA Outstanding Leadership Medal, as well as other NASA commendations and awards.



COLLEGE OF ENGINEERING DISTINGUISHED ENGINEERING ALUMNA 2017 AMY HESS

SPECIAL AGENT IN CHARGE,
LOUISVILLE (KENTUCKY) FIELD OFFICE,
FEDERAL BUREAU OF INVESTIGATION
BSAAE '89

FOR HER SERVICE IN VARIOUS KEY ROLES WITHIN THE FEDERAL BUREAU OF INVESTIGATION, FROM SPECIAL AGENT TO EXECUTIVE ASSISTANT DIRECTOR OF THE SCIENCE AND TECHNOLOGY BRANCH, AND FOR HER SIGNIFICANT CONTRIBUTIONS TO HOMELAND SECURITY AND FIGHTING CYBERTERRORISM



Amy Hess' high hopes for a career, even as a young girl growing up in Jeffersonville, Indiana, had always been "to be an astronaut or an FBI agent." The inspiration for the latter grew stronger when she toured FBI headquarters during a Washington, D.C., trip with her parents when she was 11 years old.

Her years at Purdue — the "Cradle of Astronauts" — could easily have put Hess on a path to space. Instead, after earning her BSAAE in 1989, she answered a call from the FBI, which was looking for people from the science and engineering fields, and became a special agent. She has worked for the FBI ever since.

During a decade as a special agent in Kansas City and Louisville, Hess tapped into her AAE

training. "My Purdue education has been very applicable," she says. "It taught me to critically think through problems and come up with solutions. Additionally, I found that a degree from Purdue brings instant credibility. I'm convinced it helped me to be considered for opportunities that I might have not otherwise had."

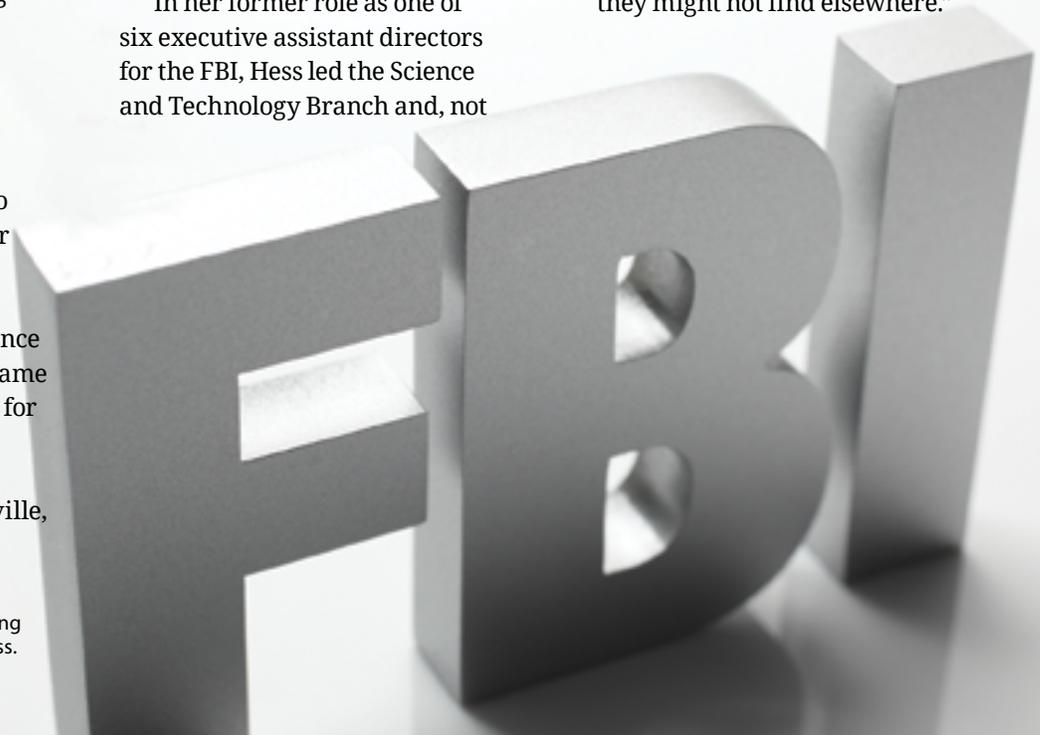
Hess has worked on some of the nation's biggest criminal cases, including the Oklahoma City bombing in 1995. She also has been at the forefront of homeland security and cyberterrorism issues and has testified before Congress about the encryption debate on cell phones and about plans for ramping up DNA technology. She has addressed the challenges of cybercrimes that can put perpetrators from the other side of the world directly into a living room laptop on any street in America.

In her former role as one of six executive assistant directors for the FBI, Hess led the Science and Technology Branch and, not

surprisingly, encourages a scientific approach to fighting crime. "One of the things I really value about our branch is the way people think," she says. "Someone comes up with a hypothesis and then tries to discredit the hypothesis by taking a contrary point of view. That's helpful because it makes you deconstruct the problem by thinking like scientists and engineers."

After more than a quarter of a century with the FBI, Hess wouldn't trade her accomplished career for the moon — literally. She's returned to Purdue on a few occasions, and she always encourages students — technophiles and engineers alike — to consider options seemingly off the traditional career track. "It's hard for the government to compete with private-sector salaries," she says. "But we can provide a sense of purpose and mission, such as service to country, they might not find elsewhere."

ABOVE / Former Dean Leah Jamieson (right) presents the College of Engineering Distinguished Alumni Award to Amy Hess.





AAE alum awarded **NASA** DISTINGUISHED PUBLIC SERVICE MEDAL

AAE alumnus Frank Bauer (BSAAE '79, MSAAE '80) has received the NASA Distinguished Public Service Medal. This is the highest honor NASA awards to anyone who was not a government employee for making a contribution representing substantial progress to the NASA mission.

The individual's achievement or contribution must be deemed so extraordinary that other forms of recognition by NASA would be inadequate. Bauer was recognized for "distinguished public service in enabling the enhanced use of the Global Positioning System for satellites by NASA and the United States."



FROM LEFT / Robert Lightfoot, NASA acting administrator; Frank Bauer; and Lesa Roe, NASA acting deputy administrator. PHOTO: NASA

Bauer retired from NASA in 2011 after a 30-year career, but continued to support NASA in Global Positioning System (GPS) technology and policy. He represented NASA and the U.S. at five international meetings in the last five years. According to NASA, "without Mr. Bauer's work, the U.S. would not have the GPS capabilities or reputation it does in the world navigation community."

Bauer previously received the Exceptional Service Medal, the Outstanding Leadership Medal and the Silver Snoopy Award from NASA. He received the Outstanding Aerospace Engineer Award from Purdue's School of Aeronautics and Astronautics in 2008.

Blue Origin team member selected for **COLLIER TROPHY**

AAE alumna Yen Matsutomi (BSAAE '03, MSAAE '05 and PhD AAE '09) represented the Blue Origin New Shepard team at the competition for the 2016 Robert J. Collier Trophy, along with Jeff Ashby, chief of mission assurance at Blue Origin. The Collier Trophy is presented annually by the National Aeronautic Association "... for the greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency, and safety of air or space vehicles,

the value of which has been thoroughly demonstrated by actual use during the preceding year."

Blue Origin's New Shepard team won the award "... for successfully demonstrating rocket booster reusability with the New Shepard human spaceflight vehicle through five successful test flights of a single booster and engine, all of which performed powered vertical landings on Earth."

Matsutomi joined Blue Origin in 2010 as a combustion devices development engineer, where she was responsible for developing the injector for the revolutionary BE-3 engine that powers New Shepard. She is currently lead of the injector design and development group at Blue Origin, with responsibility for development across different engine program groups.



FROM LEFT / Jeff Ashby and Yen Matsutomi with Jim Albaugh, chairman of the National Aeronautic Association

2017 OUTSTANDING AEROSPACE ENGINEER AWARDS



PICTURED FROM LEFT / Tom I. P. Shih, Jonathan M. Edwards, Emmanuel G. Collins, Kevin K. Parsons, Todd C. Probert, Tim S. Cahill, Richard A. Roski, Mark A. Sleppy, Julie Kramer White and Jordi Puig Suari

The Purdue University Outstanding Aerospace Engineer Award recognizes the professional contributions of graduates from the School of Aeronautics and Astronautics and thanks them for the recognition that their success brings to Purdue and the school.

In 2017, the school was pleased to honor nine graduates of AAE with the designation “Outstanding Aerospace Engineer.” The award banquet took place April 21, 2017.

Criteria for the award state that recipients must have demonstrated excellence in industry, academia, governmental service or other endeavors that reflect the value of an aerospace engineering degree. The 180 OAEs represent just over 2 percent of the more than 8,500 alumni of Purdue’s School of Aeronautics and Astronautics.

**Congratulations to our
2017 Outstanding
Aerospace Engineers!**

TIM S. CAHILL

Vice President, Air and Missile Defense
Lockheed Martin Corp.
BSAAE 1987 • MSAAE 1988

EMMANUEL G. COLLINS

John H. Seely Professor and Mechanical
Engineering Dept. Chair
Director, Center for Intelligent Systems,
Control, and Robotics
Florida A&M University
Florida State University College of Engineering
PhD AAE 1987

JONATHAN M. EDWARDS

Senior Director of Vehicle Engineering
Falcon 9 Product Director
SpaceX
BSAAE 2001 • MSAAE 2004

JULIE KRAMER WHITE

Chief Engineer
Orion Multi Purpose Crew Exploration Vehicle
NASA
BSAAE 1990

KEVIN K. PARSONS

Director of Innovation and Transformation
Northrop Grumman Corp.
BSAAE 1996

TODD C. PROBERT

Vice President, Mission Support and
Modernization
Intelligence, Information, and Services
Raytheon Co.
MSAAE 1989

JORDI PUIG-SUARI

Professor of Aerospace Engineering
Cal Poly San Luis Obispo
BSAAE 1988 • MSAAE 1990 • PhD AAE 1993

RICHARD A. ROSKI

Chief of Neurosurgery
Cleveland Clinic Florida
BSAE 1971

MARK A. SLEPPY

Technical Fellow
Boeing Co.
BSAAE 1985



In Memoriam

1940s

Dr. Thomas C. Adamson Jr.
(BSAE '49) October 9, 2016

Richard A. Beckert
(BSAE '49) October 1, 2016

George E. Buecheler
(BSAE '49) August 11, 2016

William T. Curdts III
(BSAE '48) January 3, 2017

Paul F. Keller
(BSAE '46) February 10, 2017

Ralph L. LeFevre
(BSAE '49) April 1, 2017

M. Keith Marshall
(BSAE '46) October 28, 2016

David H. Rodgers
(BSAE '47) April 18, 2017

Robert H. Rupkey
(BSAE '49) January 18, 2017

Albert J. Stefan
(BSAE '49) January 21, 2017

Dr. Vern C. Vanderbilt Jr.
(MSAE '47) April 10, 2017

Joseph K. Voelz
(BSAE '49) March 25, 2017

1950s

Charles G. Allen
(BSAE '51, MSAE '52)
November 8, 2016

Wallace P. Blankenship Jr.
(BSAE '50) May 28, 2017

G. Porter Bridwell
(BSAE '58) August 4, 2016

David A. Byrne
(BSAE '59) June 15, 2017

Richard L. Cunningham
(BSAE '51) December 16, 2016

Warren R. Evans
(BSAE '50) February 2, 2017

L. Dale Felix
(BSAE '51) March 15, 2017

Evard H. Flinn
(BSAE '53) March 20, 2017

Dennes P. Forsmo
(BSAE '57) November 11, 2016

Anthony Fortini
(BSAE '51, MSAE '53)
January 7, 2017

William A. French
(BSAE '51) November 23, 2016

Richard G. Geib
(BSAE '56) March 21, 2017

Rex B. Hagen
(BSAE '50) June 17, 2017

David J. Haykin Jr.
(BSAE '53) December 23, 2016

Marshall D. Henshaw Jr.
(BSAE '52) April 19, 2017

John R. Hinchman
(BSAE '57) December 27, 2016

Raymond A. Jankowski
(BSAE '50) October 13, 2016

Edwin Johnston Jr.
(BSAE '57) December 12, 2016

Edmund H. Johnstone Jr.
(BSAE '57) November 28, 2016

H. Robert Kietzman Jr.
(BSAE '50) November 1, 2016

Floyd F. Koogler Jr.
(BSAE '51) October 6, 2016

William T. Kowal
(BSAE '58) April 2, 2017

John P. Krisciunas
(BSAE '54) December 22, 2016

John A. Langley
(BSAE '50) March 29, 2017

Frank A. Matthews
(MSAE '57) May 31, 2017

Paul G. McClanahan
(BSAE '50) October 11, 2016

Daniel J. O'Brien
(BSAE '55) December 12, 2016

James E. Plemel
(BSAE '51) January 11, 2017

W. Douglas Smith
(BSAE '52) May 20, 2017

Louis M. Thorpe
(BSAE '53, MSAE '56)
April 18, 2017

John W. VanderHoven
(BSAE '53) August 11, 2016

Robert F. Wernet
(BSAE '51) January 15, 2017

Robert L. Whitlock
(BSAE '51) February 1, 2017

Maurice F. Winkler Jr.
(BSAE '54) August 18, 2016

1960s

Ralph E. Alden
(BSAE '61) November 16, 2016

Stellios A. Avramidis
(BSAE '67) October 9, 2016

David J. Carter
(BSAE '66) June 18, 2017

Dr. Jay C. Hardin
(BSAE '64, MSAE '65, PhD AE '69)
June 4, 2017

Stephen D. Hollingsworth
(BSAE '67) December 23, 2016

Michael W. Hyer
(MSAE '66) February 14, 2017

Nolan E. James
(BSAE '61) November 4, 2016

Franklin D. Roberts
(BSAE '62) September 23, 2016

Robert L. Shaw
(BSAE '69) March 15, 2017

M. Andrew Simo
(BSAE '61) May 18, 2017

Angelo A. Stambolos
(BSAE '69) June 7, 2017

1970s

Richard A. Link
(BSAE '71) January 10, 2017

James M. McKinstry
(BSAE '71) October 24, 2016

Stephen K. Workman
(BSAAE '73) October 23, 2016

1980s

Douglas S. Whitehead
(BSAAE '82) May 12, 2017

Capt. Pamela J. Wolosz
(BSAAE '86) January 10, 2017

2000s

Laura K. Markee
(BSAAE '08) September 16, 2016

Lionel Zhen Yu Tan
(BSAAE '06) January 14, 2017



Hsichun (Mike) Hua
January 24, 2017

Hsichun (Mike) Hua (MSAE '65, PhD AE '68) was known in Taiwan as the "Father of the IDF fighter jet." He

graduated from the Chinese Air Force Academy and worked as a military pilot in Taiwan before attending Purdue. Hua went on to work for Cessna and Lockheed Aircraft before returning to Taiwan in 1970 to participate in establishing an aircraft industry there. In 1959, Hua made an emergency landing that is legendary among U-2 pilots and earned him a Distinguished Flying Cross from the U.S. Air Force. Hua received the Distinguished Engineering Alumni award from Purdue's College of Engineering in 1990 and the Outstanding Aerospace Engineer Award from Purdue AAE in 1999.



Paul E. Petty
October 10, 2016

Paul Eugene Petty (BSAE '53) grew up on a small farm in southern Indiana, and at 18 joined the Navy, where he became a pilot. After his military service, he attended Purdue, then went on to start his career at Chance Vought, where he worked on the same types of fighter planes he had flown in the Navy. In 1960, he went to work at General Electric, where he pioneered reconnaissance satellite systems that helped maintain the peaceful balance of power between the United States and Soviet Union. In 1968, Petty joined Perkin Elmer, where he helped build the Hubble Space Telescope. He received the Purdue AAE Outstanding Aerospace Engineer Award in 2014.



PURDUE SPACE DAY

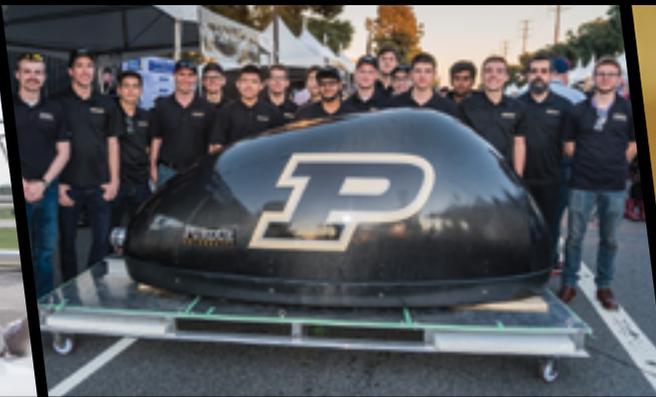
The 21st annual Purdue Space Day featured VIP guest Jerry Ross (BSME '70, MSME '72), who started the day with a talk to the hundreds of children in attendance. Purdue student volunteers (pictured at right with Jerry Ross) then led participants through hands-on STEM activities (stomp rockets, shown above) with a space theme.

With support from AAE, the Indiana Space Grant Consortium, corporate partners and individual donations, Purdue Space Day seeks to inspire the next generation of space explorers through STEM outreach in the local community.

Purdue Space Day 2017 is Oct. 21 with VIP guest astronaut Mark Polansky (BSAAE, MSAEE '78).

PHOTOS: PURDUE SPACE DAY





THANK YOU

EACH GIFT the Purdue School of Aeronautics and Astronautics receives enhances the educational experience we are able to provide our students. **WE STRIVE TO OFFER FUNDING** for our student organizations, graduate student research and our design build test classes. Through the **INVOLVEMENT AND GENEROSITY** of alumni and friends like you, the School of Aeronautics and Astronautics continues to maintain its high standard of academic preeminence. **PRIVATE SUPPORT** plays an integral role in our ability to serve our students, faculty and the greater community. Each gift is an affirmation of our mission of education, research and outreach. **WE THANK YOU** for helping to grant opportunities for future generations of aerospace engineers!

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LEFT / Graduate student Nicoletta Fala, pilot on the first AAE sponsored Air Race Classic team.

CENTER / The Purdue Hyperloop team poses with its high speed pod.

RIGHT / Students Kate Fowee and Alexandra Dukes attended the 55th Robert H. Goddard Memorial Symposium in Greenbelt, Maryland, thanks to a grant from AAE.