

Longhorn

LIFTOFF

UNDERSTANDING
LAND AND STORM,
USING RADAR AND
MACHINE LEARNING

PAGE 8

HIGHER, FASTER:
NEW NASA
UNIVERSITY
LEADERSHIP
INITIATIVES

PAGE 14

SENIOR DESIGN TEAM
WINS FOR VENUS
LANDER

PAGE 16



The University of Texas at Austin
Aerospace Engineering
and Engineering Mechanics
Cockrell School of Engineering



CONTACT US

LONGHORN LIFTOFF

Longhorn Liftoff is published for alumni and friends of the Department of Aerospace Engineering and Engineering Mechanics in the Cockrell School of Engineering at The University of Texas at Austin.

EDITORIAL

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FROM THE CHAIR

LOOKING FORWARD

This past academic year has consisted of a whirlwind of activity and excitement, along with a great deal of uncertainty. I applaud everyone in our community – from students, to faculty, to staff and alumni – for their continuous hard work and dedication as we begin returning to campus for in-person learning this fall. In this issue of Longhorn Liftoff, we feature a variety of stories that highlight the important problems these members of our community are working to solve. I continue to be amazed by their tenacity, ingenuity and creativity, and I encourage you to take some time to learn more about their impactful work in the pages that follow.

I am looking forward to meeting many of you in person when it is once again safe for us to hold large gatherings on campus. Stay tuned for more information. Until then, please remember to keep in touch with your news and updates. It's always inspiring to see how our Texas ASE/EM alumni are making a difference while they are out changing the world.

Hook 'em Horns!

CLINT DAWSON

CHAIR, DEPARTMENT OF AEROSPACE ENGINEERING AND ENGINEERING MECHANICS
J.J. MCKETTA CENTENNIAL ENERGY CHAIR IN ENGINEERING



WATCH CLINT DAWSON'S WELCOME VIDEO ON YOUTUBE

bit.ly/WatchASE

YouTube

PROMOTED *to* PROFESSOR

Three faculty members were promoted to the rank of professor in 2021. All have made significant impacts on the department's teaching and research efforts.

SRINIVAS BETTADPUR



Srinivas Bettadpur's research expertise lies in space geodesy, for the study of the dynamics of the Earth system on global and regional scales, using satellite gravity and precision position determination from space. He has been recognized for his leadership role on the high-profile GRACE and GRACE-FO satellite missions, both of which have provided important data on the rate of melting ice, rising ocean levels, depleted aquifers and more. Bettadpur was instrumental in the establishing a UT-NASA partnership for a next-generation geodetic observatory at UT's McDonald Observatory in West Texas, which will enable a generational shift in the metrology and characterization for natural hazards. He was named the director of the Center for Space Research (CSR) in 2018, where he also served as a research professor. Bettadpur earned his Ph.D. from The University of Texas at Austin. He holds an appointment in the Department of Geological Sciences in the Jackson School of Geosciences and is an affiliate of the UT Applied Research Laboratory.

TODD HUMPHREYS



Todd Humphreys specializes in the application of optimal detection and estimation techniques to problems in satellite navigation, autonomous systems and signal processing. He is world-renowned for pioneering research on the security of GNSS (Global Navigation Satellite Systems) and has exposed the vulnerability of GNSS multiple times. His team was the first to successfully spoof a civilian drone in 2012 and the following year, took on an even bigger challenge, spoofing an \$80 million superyacht at sea. Humphreys is also credited for bringing precise GPS to the mass market and was the first to demonstrate centimeter-accurate RTK (real-time kinematic) positioning using a smartphone antenna. He has testified three times before the U.S. Congress and is a recipient of numerous awards including the Presidential Early Career Award for Scientists and Engineers (PECASE), the NSF CAREER Award, the Institute of Navigation Thurlow Award and the UT Regents' Outstanding Teaching Award. Humphreys directs the Radionavigation Laboratory at UT Austin and is the incoming director of the Wireless Networking and Communications Group.

RYAN P. RUSSELL



Ryan P. Russell's research focuses on solving orbital mechanics problems as they are related to space utilization and exploration. His research areas of interest include space flight mechanics, numerical optimization, trajectory design, and spacecraft dynamics. Projects are funded from a variety of sponsors, including NASA, federally funded R&D Centers, the Department of Defense and various industry partners. Russell began his professional career at NASA's Jet Propulsion Laboratory as a member of the Guidance, Navigation and Control section where he worked as a mission designer and navigation analyst for a variety of space flight projects. He served on the Georgia Institute of Technology faculty from 2007-2011 before joining the UT ASE/EM faculty in 2012. He has authored or co-authored over 200 technical publications and is a recipient of several NASA, JPL, AIAA, AAS and other awards. ■

TABLE OF CONTENTS

ON THE COVER

PAGE 8

LAND AND STORM

How land types influence storm risks using radar and machine learning

DEPARTMENT UPDATE

PAGE 11

A CLOSER LOOK

ASE/EM facts and impact numbers

FACULTY & RESEARCH

PAGE 7

SPACE JUNK IN THE TRUNK?

Moriba Jah, Neil deGrasse Tyson on StarTalk

PAGE 14

HIGHER, FASTER

Faculty lead new NASA University Leadership Initiatives

PAGE 21

NEWEST FACULTY MEMBER

David Fridovich-Keil

STUDENTS

PAGE 4

STUDENT RECOGNITION

PAGE 6

MEET KATHARINE FISHER

Cockrell's Outstanding Scholar-Leader

PAGE 16

FORGET MARS

Students win NASA design competition for their Venus lander

ALUMNI

PAGE 18

BLAST FROM THE PAST

PAGE 20

ALUMNUS AND BLUE ORIGIN

CEO BOB SMITH

On Smith's origins in aerospace

PAGE 22

ACADEMY OF DISTINGUISHED

ALUMNI INDUCTEES

STUDENT RESEARCH RECOGNITION

Students and Alumni Win Prestigious Fellowships and Awards for Research



One step closer to the edge of space 🤘🚀

@texasrocketlab successfully pulled off the liquid hot-fire test of their liquid bi-propellant rocket, Halcyon.

The milestone (and continued success since this first test) moves TREL toward their goal of becoming the first-ever student team to design, build and launch a liquid bi-propellant rocket to the Karman Line... the boundary between Earth's atmosphere and outer space 🤯

WATCH THE VIDEO:
bit.ly/TREL-HotFire

GRADUATE Fellowships and Awards



MATTHEW ASPER



**Ph.D. Student, Aerospace Engineering
National Defense Science and Engineering Graduate Fellowship**

Faculty Advisor: Jayant Sirohi

Graduate Research: Asper is investigating a novel vertical flight aircraft configuration that includes both computational modeling and experimental testing to predict and validate the performance of this unique aircraft concept.

KAYLEE CHAMPION



**B.S. Aerospace Engineering 2021
National Science Foundation Graduate Research Fellowship**

Faculty Advisor: Srinivas Bettadpur

Undergraduate Research: Used case tests to better understand how non-spherical shaped spacecrafts charge and create a more accurate Lorentz force model.

Graduate Institution: Pursuing a Ph.D. in aerospace engineering at UC Boulder working in the Autonomous Vehicle System (AVS) lab with Dr. Schaub.

KATHARINE FISHER



**B.S. Computational Engineering 2021
National Science Foundation Graduate Research Fellowship**

Faculty Advisors: Brandon Jones, Karen Willcox

Undergraduate Research: Predicted the movement of debris in space by propagating the orbit and rotation of the debris at different rates in time (Jones) and used multiple computational models to efficiently estimate the error of a highly accurate computational model (Willcox).

Graduate Institution: MIT; plans to become a professor in computational engineering.

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RYAN KELLY



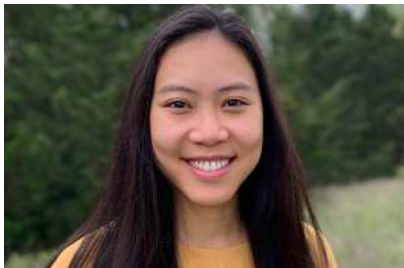
First Year Ph.D. Student, Aerospace Engineering

National Science Foundation Graduate Research Fellowship

Faculty Advisors: David Goldstein and Philip Varghese

Graduate Research: Kelly is researching how buoyant particles move in an incompressible flow with applications in drag reduction using computational fluid dynamics (CFD). The research aims to simulate a particle with a polymer payload which can be released in a turbulent boundary layer to disrupt the turbulent structures, thereby reducing drag.

JULE VI PHAM



M.S./Ph.D. Student, Aerospace Engineering

National Science Foundation Graduate Research Fellowship

Aviation Week Network's 20 Twenties

Faculty Advisor: Karen Willcox

Graduate Research: Pham is developing a novel sensing strategy for hypersonic environments, called the Full-Airframe Sensing Technology (FAST). The strategy employs inverse methods with machine learning to infer quantities of interest, such as distributed pressure loads, from indirect measurements of structural deformation. The FAST methodology can enable advanced hypersonic vehicles with predictive sensing and control capabilities.

REBECCA WANG



B.S. Aerospace Engineering

National Science Foundation Graduate Research Fellowship

Faculty Advisor: Under rotation with Mac Schwager

Graduate Research: Wang is studying inverse reinforcement learning/meta learning applied to autonomous driving in the Astronautical and Aeronautical Engineering Department at Stanford University.

UNDERGRADUATE Awards



CATHERINE DOMINIC



Aerospace Engineering Major

Brooke Owens Fellowship: Supports young women and other gender minorities pursuing careers in the aerospace industry; provides a paid internship opportunity.

Internship: Dominic interned at Amazon Prime Air using the skills she learned on the UT Design, Build, Fly team working on composites.

JOSHUA DAVIS



Aerospace Engineering Major

Patti Grace Smith Fellowship: Aims to bring diversity to the U.S. aerospace industry and offers a paid internship at a leading aerospace engineering firm.

Internship: Davis interned on the Space Systems team at Airbus U.S. Space and Defense.

MARCOS BOTTO TORNIELLI



Computational Engineering Major

Graham Carey Undergraduate Scholarship

Research: Tornielli has participated undergraduate research with David Goldstein in the Computational Fluid Physics Lab. He also worked on the visualization of storm surge model results in Clint Dawson's Computational Hydraulics Group, where he is still conducting research. ■



TO SUPPORT OUR STUDENT PROGRAMS, VISIT

ae.utexas.edu/alumni/giving

"I AM VERY GRATEFUL TO HAVE BEEN SELECTED FOR THIS AWARD AND I GREATLY APPRECIATE THE SUPPORT FOR MY FUTURE CAREER IN COE."

—Marcos Botto Tornielli, Computational Engineering Major

MEET KATHARINE FISHER

Computational engineering major Katharine Fisher is this year's Outstanding Scholar-Leader for the Cockrell School of Engineering — an award that recognizes one graduating student annually for hard work and leadership inside and outside the classroom. However, things may have been very different had she not decided to check out an engineering outreach program on a whim in high school.

The California-born, Texas-raised Fisher was always interested in building things and solving hard problems as a kid, a staple of the engineer's brain. But her early schooling did little to encourage this mindset, and slowly her interest in engineering and science drifted away. That is, until she attended a workshop put on by the nonprofit Project Lead the Way in high school in Melissa, Texas, a small town about 40 miles north of Dallas. Fisher wasn't all that interested in the science program itself, but she knew some people who were going, so she tagged along.

She never saw herself as a scientist or an engineer — due to lack of exposure to the fields and how they were depicted in pop culture. But once she got some hands-on experience in the outreach program, it all changed. "I ended up seeing that there was a lot of creativity in engineering that I didn't know existed," she said. "Seeing the excitement other people had for the field made me think of it as something I wanted to do, which led directly to me deciding to study engineering and make it a career."

Now, a few years later, Fisher has graduated from The University of Texas at Austin, with dual degrees in computational engineering and mathematics from the Department of Aerospace Engineering and Engineering Mechanics and the Department of Mathematics, respectively. She finished with a 4.0 GPA, no easy feat in one of the top engineering schools in the nation.

Her research generally focuses on mathematics-based computational models, which can be applied to any number of fields. Her two main focal points are analyzing models themselves to find

and reduce error rates, and studying space debris.

Up next, Fisher is heading to graduate school, with an ultimate goal of becoming a professor of computational engineering. Outreach to the next generation of prospective engineers is a major part of her career goals.

"I definitely want to make that a part of every stage of my career; I want to show more people like me — who saw engineering as a very distant career path — that it is viable," Fisher said.

From the moment she stepped foot on campus, Fisher has been dedicated to spreading the word about engineering. She was involved with Women in Aerospace for Leadership and Development, an 11-year-old student organization that aims to attract and retain more women in engineering and help them develop leadership skills. The organization also organizes outreach events for middle and elementary school students to raise interest in STEM. Fisher also served as an ambassador for prospective computational engineering students, a duty she performed remotely during the pandemic, adding an extra layer of difficulty.

Fisher moved to Boston this summer in preparation to attend MIT in the fall, with a few friends in tow. She looks forward to getting to know the new city and keep up with her hobbies of reading and crocheting, which it turns out, is a lot like engineering.

"It's interesting how similar a knitting or crochet pattern is to a computer program," Fisher said. "I didn't realize how algorithmic the process was until I started studying engineering." ■



STARTALK

SPACE JUNK, STARLINK AND FALLING ROCKETS

Associate professor and space environmentalist Moriba Jah joined Neil deGrasse Tyson (a UT Astronomy alumnus) and comedian Chuck Nice on Tyson's StarTalk series to discuss the space junk problem and how to manage objects in orbit.

bit.ly/jah-star-talk



EARLY CAREER AWARDS



Manuel Rausch received a National Science Foundation CAREER Award for his proposal, "Toward a Fundamental Understanding of Why Thrombus Dissolves, Persists, or Breaks Off." The award will be used to develop experimental and computational strategies that will provide a better understanding of the biophysical properties of blood clots.



Thomas Underwood received the Air Force Office of Scientific Research Young Investigator award for his proposal, "Air-Breathing Magneto-Deflagration Propulsion for Sustained Very Low Earth Orbit." The award will be used to develop a novel type of electromagnetic propulsion.

**INTERFERROGRAM OF
HOUSTON, TEXAS**

This is an example of the InSAR measurements. An interferogram can be considered as the difference between two SAR images acquired over the same area at different dates. The color of a pixel represents how much the land surface has moved between the two acquisition dates.



LAND AI

An aerial photograph of a forest with a river winding through it. A satellite dish is superimposed over the image, partially overlapping the title text.

LAND STORM

TECH CAN TELL US WHICH TYPES OF LAND SLOW STORM SURGE

The types of land around us play an important role in how major storms will unfold — flood waters may travel differently over rural versus urban areas, for example. However, it's challenging to get an accurate picture of land types using only satellite image data because it is so difficult to interpret.

Researchers in the Department of Aerospace Engineering and Engineering Mechanics have, for the first time, applied a machine learning algorithm to measure the surface roughness of different types of land with a high level of detail. The team used a type of satellite imagery that is more dependable and easier to capture than typical optical photographs but also more challenging to analyze. And they are working to integrate this data into storm surge models to give a clearer picture of what will happen during major weather events.

"YOU CAN IMAGINE THAT WHEN A STORM APPROACHES LAND IT WILL MOVE MUCH FASTER AND FARTHER OVER OPEN OR BARREN LAND. AND, IN CONTRAST, STORMS MOVE SLOWER OVER ROUGHER SURFACES LIKE DENSELY VEGETATED FORESTS," SAID KE WANG, A GRADUATE RESEARCHER IN THE LAB OF ANN CHEN, AN ASSISTANT PROFESSOR IN THE ASE/EM DEPARTMENT.

Today, the main source for data about land types comes from the National Oceanic and Atmospheric Administration. But that data is only updated every five or six years, making it hard to get a clear picture of how the land changes over time. The researchers aim to make their land data capable of at least annual updates and, ideally, more frequent than that.

For their experiment, the team analyzed publicly available Synthetic Aperture Radar, or SAR, images taken from a Japanese satellite. SAR images are different from the powerful cameras in other satellites because they actively illuminate the ground using radar signals rather than relying on light from the sun, which may be limited at night or when cloud cover is present.

Standard, physics-based models have struggled to accurately analyze these types of images. But the team's machine learning algorithm was able to create a clear enough picture of land roughness data that the information could be used in storm surge modeling.

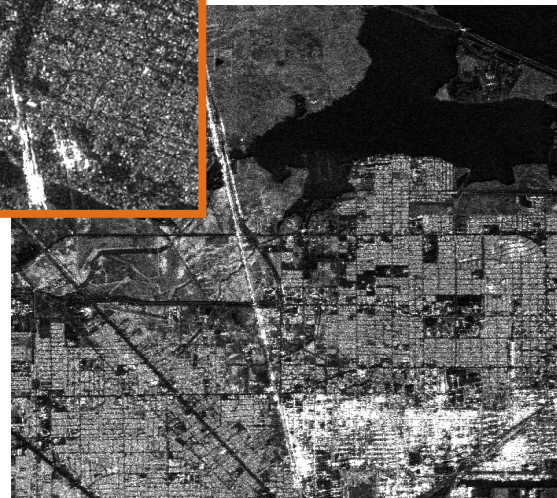


◀ THE FORTY ACRES

Zoomed-in SAR amplitude image over downtown Austin and UT campus. We can see that the narrow dark strip is Colorado river, and the super bright block at the bottom right of the image is the I-35 bridge.

LA MARQUE

Zoomed-in SAR amplitude image over the city of La Marque and Texas city, Houston, TX, which is very close to the Texas coast. The dark areas shown in this figure are mostly water. The super bright area at the bottom right part of the figure is an industrial area with lots of oil-production facilities. A storm surge can cause a large amount of economic loss when it hits this area.



Using these publicly available satellite images, the algorithm automatically classifies different types of land by analyzing characteristics such as topography and brightness from the satellite data. The research primarily focused on areas along the Gulf Coast around New Orleans and Houston, where rapid land changes and increases in strong storms put these major cities more at risk for significant damage.

The team is working with Clint Dawson, professor and chair of the Department of Aerospace Engineering and Engineering Mechanics and leader of the Oden Institute's Computational Hydraulics Group, to adapt the data for his storm surge models.

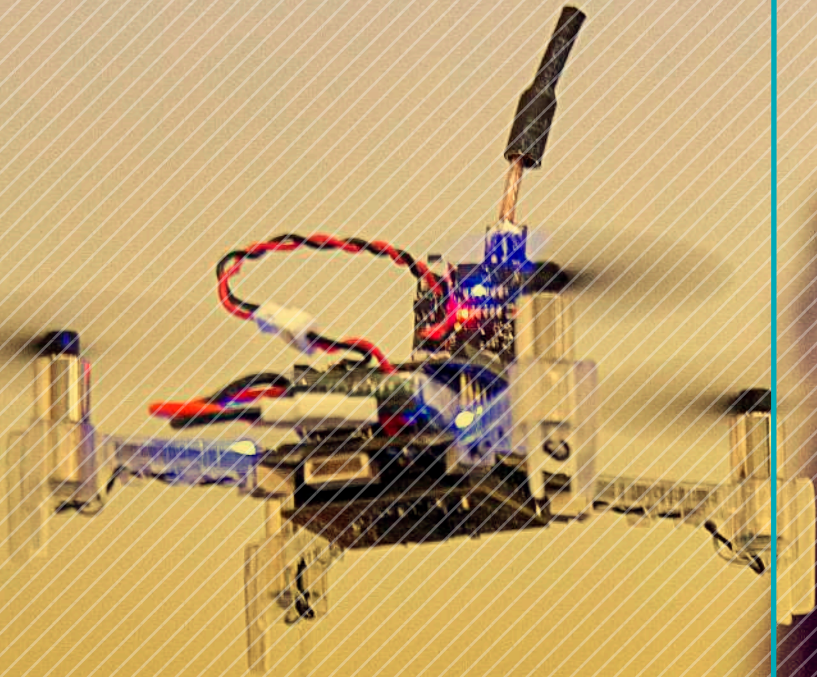
"Storm surge is a competition between wind pushing water towards the coast, and the coast's ability to withstand the force of the surge," Dawson said. "There is a big difference in storm surge when the coast is covered with flexible grass versus thick trees such as mangroves. The Texas coast is particularly vulnerable to surge because it is primarily low-lying marshland and prairie. Therefore, knowing the type of land cover in a coastal region is essential to being able to mitigate and predict storm surge."

This data could help decision-makers contemplating methods to blunt the impact of storms, said Chen, who is the principal investigator on the paper published in IEEE Transactions on Geoscience and Remote Sensing. For example, policymakers have long debated the possibility of building "green walls" of vegetation to protect inland areas from hurricanes and other potentially dangerous storms. This information could help figure out the best places to put these green walls to protect vulnerable areas.

Though this research is mostly focused on storm surge models, there are a number of other applications. It could be used to look at forests and classify trees to understand how much potential wood supply exists and impacts of timber harvesting. And it could someday help track how land changes over time, whether due to things like deforestation, urban development or sea level rise.

But that would require improvements in satellite data. The researchers' algorithm needs approximately 10 images to make an accurate characterization of land. If it took a year to get those 10 images, it could tell what type of land is in that place, but it could not analyze how the land changed throughout the year. However, NASA is in the midst of a program to update and upgrade satellites needed to capture these images. They will collect data more regularly at a higher resolution.

"The space image data we have now is a lot more than we had 10 years ago," Chen said. "And in the next 10 years, with the quality and quantity of the data we are going to have, it's going to be a time of exponential growth." ■



A CLOSER LOOK AT
ASE/EM

DEPARTMENT OF AEROSPACE ENGINEERING
AND ENGINEERING MECHANICS

A CLOSER LOOK AT ASE/EM

STUDENTS

UNDERGRADUATE

ENROLLMENT **644**

Aerospace Engineering (ASE)	536
Computational Engineering (COE)	108

UNDERREPRESENTED POPULATIONS

Aerospace Engineering	34%
Computational Engineering	32%

WOMEN

Aerospace Engineering	23%
Computational Engineering	32%

AVERAGE STARTING SALARY

Aerospace Engineering	\$70,793
Computational Engineering	\$75,125

DEGREES AWARDED 2020-2021

Aerospace Engineering Bachelor's	121
Computational Engineering Bachelor's	20

97% of ASE undergraduates report securing employment (80%) or attending graduate school upon graduation (17%)

94% of COE undergraduates report securing employment (47%) or attending graduate school upon graduation (47%)

GRADUATE

ENROLLMENT **185**

Aerospace Engineering	153
Engineering Mechanics (EM)	32

18% women

DEGREES AWARDED 2020-2021

Master's	42
Doctoral	16

FACULTY

TENURE/TENURE-TRACK FACULTY 37

HONORS AND AWARDS

- 9** Winners, National Science Foundation CAREER Award
- 8** Fellows, American Institute of Aeronautics and Astronautics
- 7** Members, National Academy of Engineering
- 7** Fellows, American Society of Mechanical Engineers
- 4** Fellows, American Academy of Mechanics
- 4** Fellows, Society for Industrial and Applied Mathematics
- 4** Winners, AFOSR Young Investigator Program Award
- 3** Fellows, American Astronautical Society
- 1** Member, National Academy of Science
- 1** Winner, Presidential Early Career Award for Scientists and Engineers
- 1** Winner, American Heart Association Career Development Award
- 1** Winner, DARPA Young Faculty Award

FACULTY RECOGNITION

- **Maruthi Akella:** IEEE CSS Award for Technical Excellence in Aerospace Control and the American Astronautical Society Dirk Brower award for "contributions to learning and adaptive control for spaceflight applications."
- **Tan Bui-Thanh:** Elected Secretary of Society for Industrial and Applied Mathematics.
- **John-Paul Clarke:** Elected a Fellow of the Royal Aeronautical Society for his outstanding contributions in the profession of aeronautics including his work on aircraft trajectory prediction and optimization.
- **Thomas J.R. Hughes:** Eringen Medal from the Society of Engineering Science "for pioneering development of the finite element method, used worldwide in science, medicine and engineering, and for creating entirely new fields of research including mathematically rigorous stabilized methods, variational multiscale approaches, and isogeometric analysis" and the SIAM Ralph E. Kleinman Prize for his "influential and profound contributions to computational science and engineering and their impact on engineering design and simulation, while creating entirely new fields of mathematical research."
- **Todd Humphreys:** Named Fellow of the Royal Institute of Navigation "for improving understanding of GNSS vulnerabilities and pioneering the use of alternate techniques to achieve resilience."

- **Stelios Kyriakides:** Claude R. Hocott Distinguished Centennial Engineering Research Award for significant contributions in advancing the profession in engineering through documented research conducted while affiliated with The University of Texas at Austin.
- **K. Ravi-Chandar:** William Prager Medal from the Society of Engineering Science for his “outstanding work on quasistatic and dynamic fracture of ceramics, metals, polymers, and elastomers based on unique combinations of ingenious experiments and elegant analyses.”
- **Jayant Sirohi:** Technical Fellow Award by the Vertical Flight Society “in recognition of outstanding contributions to the goals and objectives of the Vertical Flight Society.”
- **Ufuk Topcu:** IEEE Antonio Ruberti Young Research Prize for “outstanding achievement in research in systems and control by a young researcher.”

RESEARCH

\$18.7 MILLION IN RESEARCH EXPENDITURES

RESEARCH AREAS

- Aerothermodynamics and Fluid Mechanics
- Computational Engineering
- Controls, Autonomy and Robotics
- Orbital Mechanics
- Solids, Structures and Materials

RESEARCH ON THE RISE

- Leading two NASA University Leadership Initiative Research projects — **Ufuk Topcu:** \$8M research project that will develop innovative solutions to managing the future of autonomous air cargo transportation; **Noel Clemens:** \$3.3M research project called FAST (Full Airframe Sensing Technology), which aims to redefine the sensing and analysis of hypersonic vehicles.
- **Clint Dawson:** Leading the UT team for a \$5.2M DOE research project to integrate computational and data infrastructure for science research; UT team will address mitigation strategies for gulf coastal flooding events due to extreme weather with AI and machine learning techniques that combine experimental data with computer simulations.
- **Nanshu Lu:** \$1.5M NSF ASCENT (Addressing Systems Challenges through Engineering Teams) Award and \$1.5M from the Army Futures Command to develop wireless e-tattoos for digitizing the human body.

IN THE U.S.

NO. 8 AEROSPACE ENGINEERING
GRADUATE PROGRAM

AEROSPACE ENGINEERING 9
UNDERGRADUATE PROGRAM
NO.

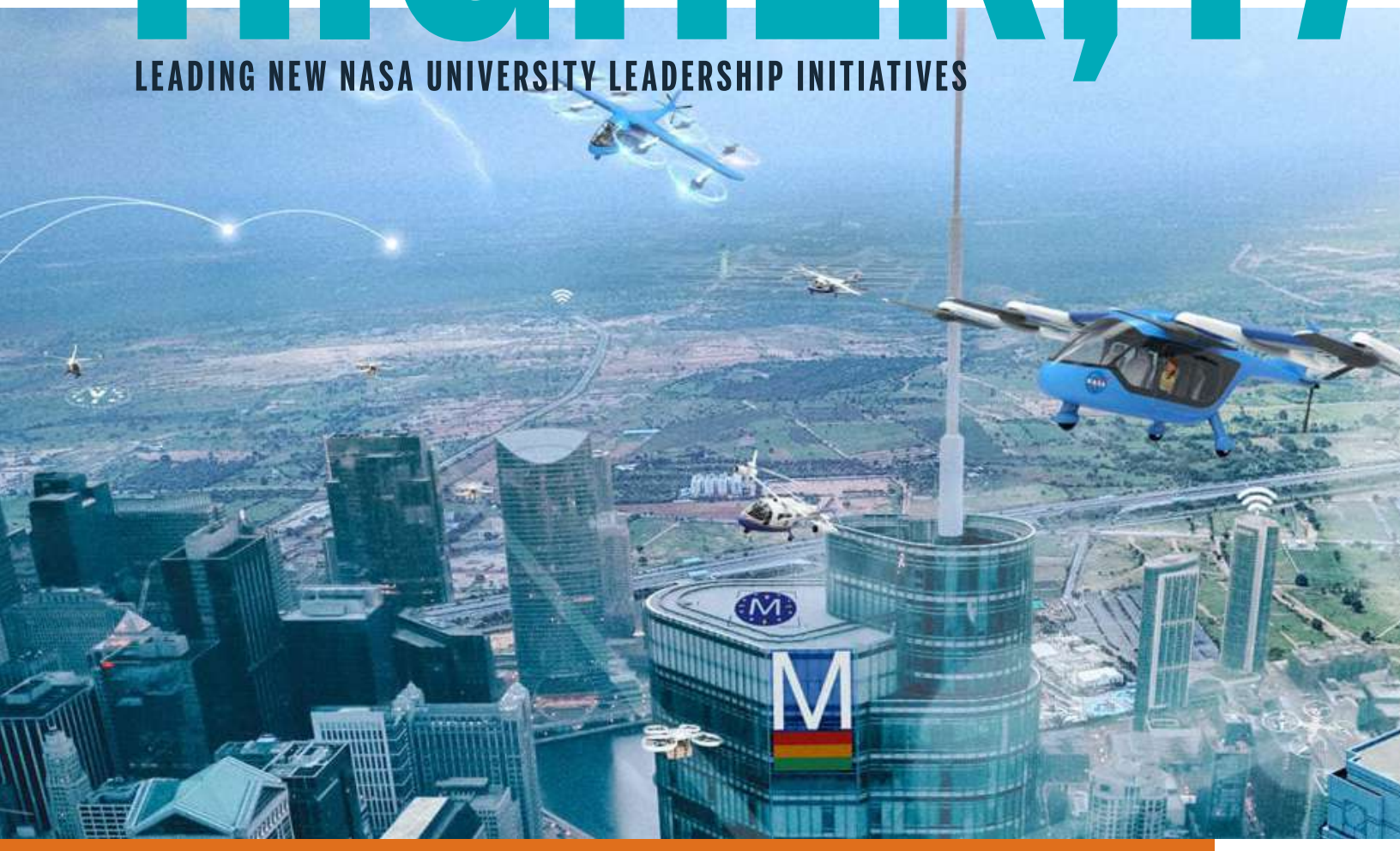
U.S. News and World Report

- **Lori Magruder:** Science team lead for the NASA's ICESat-2 (Ice, Cloud and Land Elevation 2) mission which is using satellite altimetry to look at Earth's environment from space and is measuring changes in ice sheets, glaciers and forest canopies as well as ocean depths that have never before been measured; awarded a \$1.2M Army Futures Command grant to develop an augmented world terrain for the next generation of combat vehicles.
- **Luis Sentis:** \$3M interdisciplinary UT project called CREATE; funded by the NSF to educate graduate students on the importance of developing ethical artificial intelligence.
- **Jayant Sirohi:** \$1.1M Vertical Lift Research Center of Excellence Grant from the U.S. Army/Navy/NASA.
- **Karen Willcox:** \$4.4M DOE research project titled RISE of the Machines: Robust, Interpretable, Scalable, Efficient Decision Support; awarded a \$1.9M AFOSR MURI to support research for machine learning and physics-based systems.
- **Karen Willcox, Noel Clemens, L.L. Raja, Philip Varghese and Tinsley Oden:** DOE \$16.5M Predictive Science Academic Alliance Program (PSAAP) research project to simulate a plasma torch.

FOR FULL LIST OF RESEARCH GRANTS, VISIT
bit.ly/ASE-EM-Grants

HIGHER, FA

LEADING NEW NASA UNIVERSITY LEADERSHIP INITIATIVES



Two teams of researchers in the Department of Aerospace Engineering and Engineering Mechanics (ASE/EM) and the Oden Institute for Computational Engineering and Sciences were selected to lead two of five NASA University Leadership Initiatives for 2020-21. The highly competitive ULI was developed to create relationships between the NASA Aeronautics Research Mission Directorate and the U.S. university community.

“TWO OF THE MOST PRESSING TECHNOLOGICAL ISSUES FACING THE NATION ARE AUTONOMY AND HYPERSONICS, AND UT AUSTIN IS LEADING THE WAY IN BOTH,” SAID KAREN WILLCOX, CO-PRINCIPAL INVESTIGATOR IN BOTH NASA ULI PROJECTS. WILLCOX IS ALSO A KEY DRIVER OF ANOTHER CENTRAL ELEMENT OF THE AUTONOMOUS CARGO OPERATIONS AT SCALE PROJECT: EDUCATION AND OUTREACH. “WE NEED TO BE THINKING ABOUT THE DIVERSE FUTURE WORKFORCE REQUIRED TO DESIGN, OPERATE AND MAINTAIN NEW AUTONOMOUS TRANSPORTATION TECHNOLOGIES.”

MASTER

AUTONOMOUS CARGO OPERATIONS SCALE NEW HEIGHTS

A team led by associate professor Ufuk Topcu, was granted \$8 million to lead research to develop methods that could be used to validate the cost and scalability of conceptual autonomous cargo operations. They will be providing theory and concepts for all types of vehicles — from large unmanned cargo aircraft crossing the U.S. to the single drone that can drop a package in residential neighborhoods.

The researchers will rely heavily on machine learning and computational engineering to find solutions to the long list of challenges they face, from the management of autonomous aircraft traffic flow to regulations to public concerns about safety, privacy, emissions, and noise pollution.

“Public concerns such as noise pollution, privacy or perceived risks of autonomous operations are usually addressed in a post-hoc analysis,” said Topcu. “This approach is not only costly but tends to have limited impact. We are using mathematical models to represent public concerns that characterize their relative importance with other factors in the overall process.”

Researchers will use a method that transforms societal concerns — from environmental, to safety and risk — into terrain or surfaces.

“You can create a hill for each noise-sensitive area like a school or church,” said John-Paul Clarke, a professor in the ASE/EM department and co-principal investigator on the study. “We can then modify the flight trajectory of an aerial vehicle to ensure it remains above the resulting terrain or thereby ensure the noise level at all locations stays below the noise threshold used to create the surface.”

The team includes experts from Purdue University, the Massachusetts Institute of Technology, MIT Lincoln Labs, Morgan State University and an industry partner, Cavan Solutions.

TRANSFORMING HYPERSONICS, FAST

A team led by professor Noel Clemens has received \$3.3 million to create a new paradigm in sensing for hypersonic vehicles, which could also be applied to lower-speed craft. The project, Full Airframe Sensing Technology (FAST), will treat the vehicles themselves as sensors, analyzing aerodynamic changes during flight tests, and use that information to infer where force is being applied to better protect and control the vehicles.



“We are taking conventional sensors and distributing them across the vehicle, allowing them to make measurements they weren't meant to make,” Clemens said. “By getting information from all the sensors simultaneously, we will be able to analyze the shape of the vehicle and infer the distribution of forces acting on the vehicle.”

Typical sensors are tiny and only measure a very narrow scope of information. And it's been challenging to deploy them on hypersonic vehicles because the extreme heat caused by high-speed travel causes them to burn up. By changing where sensors are placed — inside the vehicle instead of outside — and using them to track how the vehicle's physical shape changes, the team can get insights into pressure and force put on the vehicles in real time.

Changes in shape caused by the extreme force generated by hypersonic flight can knock these vehicles off their trajectory and make them harder to control. By better understanding where deformation occurs, researchers can wield superior control over the vehicles.

The researchers will use scientific machine learning methods to create computationally efficient models of the relationship between the deformations of the vehicles and the force applied during flight.

The UT FAST team is collaborating with Huston-Tillotson University, the University of Michigan, the University of Texas at San Antonio, Sandia National Laboratories and Lockheed Martin Corp. ■

FORGET MARS

VENUS IS THE PLANET ALL THE KIDS WANT TO STUDY

We've heard a lot about missions to Mars lately, but what about Venus? It's been 40 years since a spacecraft has landed on Venus. NASA's interest has spiked in Earth's planetary neighbor, and aerospace leaders of tomorrow are already tackling the hurdles of landing on our so-called sister planet.




A group of students from the Cockrell School of Engineering at The University of Texas at Austin won a NASA design contest for a Venus lander with an ambitious project that could someday, if realized, teach us a lot more about the planet. The craft, named Victrix, was created by students in the Department of Aerospace Engineering and Engineering Mechanics and it won one of the two categories of NASA's Glenn Research Challenge.

The challenge involved designing a surface system capable of ground and atmospheric analysis of Venus while surviving on the surface for at least 90 days. The team designed a spacecraft that would spend nearly half a year on an "interplanetary cruise," followed by four months of orbiting Venus. Then the craft will drop a "parent probe" and a trio of "child probes" onto the planet's surface.

"We chose to have multiple types of landers so that we could do multiple types of science and engineering — drilling and seismology — and to explore multiple sites around Beta Regio on Venus, which was a bonus for the challenge," said Grace Calkins, one of the team members and a 2021 aerospace engineering graduate. In a real-life situation, such a landing would be risky. Calkins said that boulders could damage or destroy the probes upon landing, and the terrain could block the landers' communication paths.



This challenge is the latest example of NASA's renewed interest in Venus. The organization recently announced approximately \$1 billion in funding for two new Venus missions to launch toward the end of the decade.



Crewed Artemis Mission Permanent Exploration Residence

CAMPER

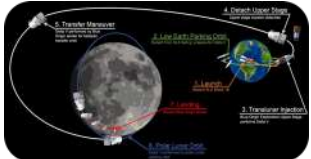
University of Texas at Austin

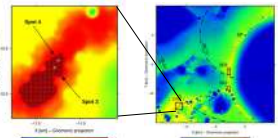
MISSION SCOPE

- A low-mass, durable lunar habitat is needed to support crewed Artemis missions of the future
- Design a habitat with a dry mass of less than 6000kg
- Support a 2-person crew at the lunar south pole for 30 days
- Innovations during CAMPER development as well as scientific discoveries on the Moon will be beneficial to life on Earth

CONCEPT OF OPERATIONS




LUNAR ENVIRONMENT



- 2 potential landing sites; both with over 90% luminosity at 10m above the lunar surface
- Spot 3: 262.42 days maximum continuous illumination, 3.17 days maximum continuous darkness
- Spot 4: 262.42 days maximum continuous illumination, 3.08 days maximum continuous darkness

DEPLOYED



STRUCTURES

- Aluminum whiplike shielding for radiation and MMOD protection
- Dual Entry: airlock for cargo, suitlocks for crew
- International Docking Adapter (reus) for future expansion

POWER

- Roll Out Solar Arrays (ROSA) offer compact storage for transport, and are mounted to a track for 360° solar tracking
- Fuel cell provides power during eclipse periods

COMMUNICATIONS

- Optical communication system allows for 622 Mbps down / 20 Mbps up (enough to stream HD video)
- Radio Frequency system consists of 1.5 m dish to connect to DSN and MEN
- Minimum SNR of 15 dB with NEN
- 2 axis gimbals system for accurate pointing

DUST MITIGATION

- Surlports reduce dust entering the habitat
- Adhesive floor paper captures dust within the airlock
- Lower floor "dust room" reduces dust entering living space
- Downward air circulation from living space to "dust room" for EVA prep (DFACS)

ECLSS

- Sabatier and oxygen generator allow the habitat to operate as a closed-loop system, reducing re-supply needs
- "Carnibalization" of Blue Moon lander reduces tank and consumables mass


THERMAL CONTROL

- 15 layer MJL reduces absorptivity and emissivity
- Patch heaters warm habitat at night along with heat generated by fuel cells
- Water and ammonia liquid cooling system in conjunction with radiators dissipate excess heat into space.

INNOVATIONS


- Hammocks serve as an adaptable, low-mass sleeping system
- 4-part dust mitigation system reduces the impact of lunar dust within the system
- Use of excess H2 and O2 on board Blue Moon lander upon arrival reduces launch capacity and optimizes resource utilization
- Dual entry system (airlock and suitlocks) improves dust mitigation and allows for ingress/egress versatility
- International Docking Adapter allows for expandability in future missions
- 360 degree sun tracking for Roll Out Solar Array (ROSA)

INTERIOR



- 90 m³ of interior volume
- 27 m² floor space
- Upper Floor serves as the crew's living space
- Restroom and private changing area
- Habitat control panel monitors CAMPER diagnostics
- Small television for video communications and crew entertainment
- Lower Floor serves as the staging area
- Access to both the airlock and suitlocks
- Service area for the suits and/or equipment
- Separation from upper level reduces risk of dust entering the living space

STOWED



- CAMPER will launch on an SLS Block 1B in it's stowed configuration inside an 8.4m PLF. Short Blue Moon Cargo Lander will be used as the lunar landing vehicle
- Launch Vehicle: NASA SLS Block 1B
- Launch Capacity: 42 tonnes to TLI
- Payload Piling: 8.4m PLF, Short
- Interior Volume: 621 m³
- Lunar Lander: Blue Moon Cargo Lander (stretch tank) with 6500 kg landing capacity
- CAMPER fits within the PLF by having the Roll Out Solar Arrays begin in the stowed configuration and the radiators collapsed against the side of the habitat
- Stowed Volume: 100 m³

ADDITIONAL WINNING STUDENT DESIGN TEAMS

Two teams of senior spacecraft mission design students were also recognized with awards in NASA's 2021 RASC-AL (Revolutionary Aerospace Systems Concepts Academic Linkage) competition. The ReVERE team won 2nd overall, Best Technical Paper and Best in Theme, and the CAMPER team won the Best Poster award.

These teams join three other UT teams who have placed in the top 15% out of over 100 entries over the past two years. RASC-AL winners usually receive a travel stipend to Florida to present their projects, but due to the pandemic, the teams received cash awards over the past two years instead.

Nokes plans to use these funds to develop hardware and a prototype for the 2021-22 RASC-AL competition.

Why all the sudden interest in the planet? Venus has a lot of characteristics in common with Earth, and NASA notes that it may have been the first habitable planet in our solar system. The missions will seek to understand how the planet went from an Earth-like climate, complete with oceans, to an uninhabitable, "inferno-like world," as NASA describes it. And this has implications for Earth and the challenges it faces with climate change.

"For me specifically, the Venus lander idea was appealing because of how little we know about Venus right now, relative to Mars," Calkins said. "When NASA originally sent probes to deep space, they chose Venus first as the most interesting target, but now Mars gets all the attention."

The UT Austin team was advised by Adam Nokes, a lecturer in the Department of Aerospace Engineering and Engineering Mechanics. The project came out of a spacecraft/mission design course for seniors. Student designers on the team included Calkins, Kaylee Champion, Zoelle Wong and Rujing Zha.

Calkins is headed to the University of Illinois at Urbana-Champaign to pursue a master's degree in aerospace engineering with a focus on entry, descent and landing; Champion plans to pursue a Ph.D. in aerospace engineering at the University of Colorado Boulder, working in the Autonomous Vehicle System lab; Zha is interning at NXP semiconductors in Austin with plans to start a Ph.D. program in mechanical engineering at Northwestern University this fall; and Wong is entering her final undergraduate year, double majoring in aerospace engineering and Chinese, with plans



WATCH THE TEAM IN ACTION ON YOUTUBE:
bit.ly/TeamVictrix

to graduate in May 2022. Wong is interning part time at the NASA Jet Propulsion Laboratory this year and plans to pursue a Ph.D. in aerospace engineering, with a focus on computational fluid dynamics.

The students complemented each other well and lauded the close relationships this challenge helped them build.

"MISSION VICTRIX WAS A REMARKABLE JOURNEY AND I COULDN'T ASK FOR A BETTER TEAM," WONG SAID. "THIS PROJECT OFFERED MANY OPPORTUNITIES FOR GROWTH BECAUSE LESS INFORMATION IS KNOWN ABOUT VENUS. EVERY TEAM MEETING FELT LIKE A NEW ADVENTURE, AND IT WAS AMAZING TO SEE OUR PROGRESS AFTER EACH MILESTONE." ■

BLAST FROM THE PAST

AMANDA ARENA, B.S. 2018, is an aerospace engineer for the Aerospace Corporation in Arlington, VA.

ERIK BALLESTEROS, B.S. ASE '19, is a hardware quality assurance engineer at the NASA Jet Propulsion Laboratory in Pasadena, CA.

"I WORK CLOSELY WITH FLIGHT PROJECT ENGINEERS TO VALIDATE THAT THEIR DESIGNS AND BUILDS ARE COMPLIANT WITH THE STANDARDS JPL INSTILLS ON ALL FLIGHT PROJECTS. MOST OF THIS WORK INVOLVES AIDING WITH DESIGN DECISIONS, PERFORMING PHYSICAL INSPECTION OF HARDWARE, AND TRAVELING ACROSS THE WORLD TO ENSURE OUR SUPPLIERS MEET THOSE EXPECTATIONS."

Read the full alumni profile at bit.ly/E-Ballesteros



Erik Ballesteros

GILBERTO BRISCOE-MARTINEZ, B.S. ASE '21, is pursuing a Ph.D. in computer science focused in human-robot interaction at the University of Colorado Boulder.



Gilberto Briscoe-Martinez

ANNE BURNHAM, B.S. ASE '04, is a graduate student of astrophysics at Yale University where she is currently studying supermassive black holes at the centers of galaxies.

JENNIFER BYRD, B.S. ASE '21, is working as a Fermi spacecraft operations system engineer at the NASA Goddard Space Flight Center for KBR in MD.

GRACE CALKINS, B.S. ASE '21 is pursuing a master's degree in aerospace engineering at the University of Illinois Urbana-Champaign with a focus on EDL (Entry, Descent and Landing) and hopes to work at JPL afterwards on interplanetary missions.



KAYLEE CHAMPION, B.S. ASE '21 is pursuing a Ph.D. in aerospace engineering at UC Boulder working in the Autonomous Vehicle System (AVS) lab with Dr. Schaub.



KATHARINE FISHER, B.S. COE '21, was selected as this year's Outstanding Scholar-Leader for the Cockrell School of Engineering. She is now pursuing a graduate degree with an ultimate goal of becoming a professor of computational engineering.



ASHA JAIN, B.S. ASE '21, is a graduate student at MIT Aero/Astro.

HYEONSEUNG "SHAWN" LEE, B.S. COE '21, joined Blue Origin as a fluid systems engineer for the new Graduate Rotation Program.



DILLAN MCDONALD, B.S. ASE '20, is a graduate student at Georgia Tech.

SANDRA (GRANT) MUSSMANN, B.S. ASE '13, is a lead systems engineer/deputy project manager at Lockheed Martin Highlands Ranch, CO and was honored with the Orion employee of the month award in October 2020.

PARVATHY PREM, PH.D. ASE '18, was honored with NASA's Solar System Exploration Research Virtual Institute's Susan Mahan Niebur Early Career Award for her work on "applying computational methods to study solar system bodies and their interactions with the space environment." She is also serving as the Science Organizing Committee co-chair for the 2021 combined NASA Exploration Science Forum/European Lunar Symposium meeting.

ANDREW RIALI, B.S. ASE '18, writes, "I have worked as a mission assurance engineer on the Cygnus program since



The NG-15 Cygnus spacecraft, the S.S. Katherine Johnson, departing from the International Space Station after completion of its resupply mission.

CREDIT: NASA

I graduated from UT in December of 2018. We are about to launch NG-16, a mission where I am a lead mission assurance engineer, and the sixth Cygnus mission I have worked on. After the launch of NG-16 in August of 2021, I will then move on to be a mission assurance engineer on Northrop Grumman's HALO mission, NASA's first module of the Lunar Gateway.”

VISHNUVARDHAN SELVAKUMAR, B.S. ASE '21, worked at SpaceX as an associate engineer with the research and development team for their Raptor engine over the summer and began attending Purdue University for a master's degree in aeronautics and astronautics with a focus on hypersonic propulsion and space system architecture research.

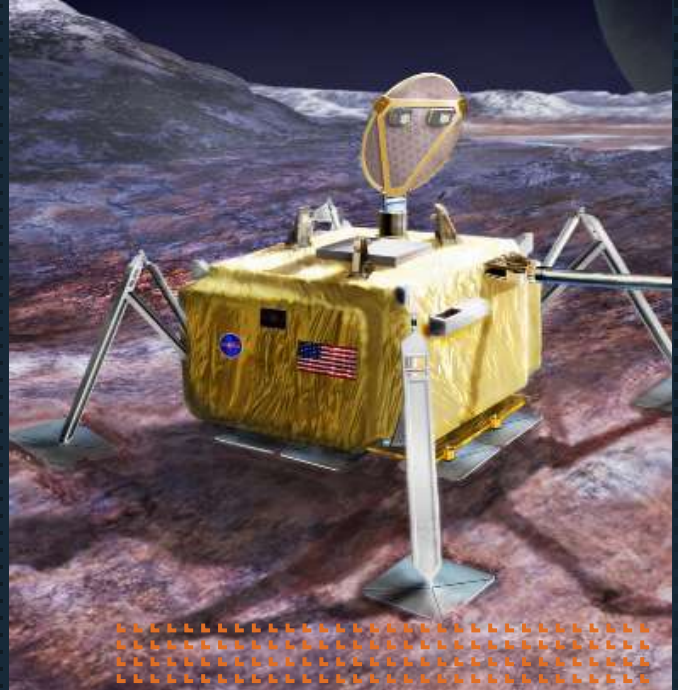
JOHN VOGEL, B.S. ASE '04, is a senior manager of flight mechanics at Advanced Development Programs.

MELANIE WEBER, B.S. ASE '04, was selected as a 2020 Outstanding Young Texas Ex. Melanie leads Crew and Cargo Accommodations for Boeing's CST-100 Starliner spacecraft. In 2019, she became the first woman and the first Hispanic person in the history of human spaceflight to lead a Launch Pad Team on the day of launch. Recently, Weber was granted a U.S. patent for innovative seats that provide Starliner crew safety and comfort. She works hard to ensure the safety of astronauts and has been recognized for her efforts with a NASA Silver Snoopy Award. Weber was featured in an episode of the Science Channel's Impossible Engineering describing Starliner's landing airbag system and was integral in unveiling Boeing's spacesuit on The Late Show with Stephen Colbert. She volunteers her time encouraging students to pursue STEM careers.



Melanie Weber

RUJING ZHA, B.S. ASE '21 interned at NXP semiconductors in Austin over the summer and is pursuing a Ph.D. in mechanical engineering at Northwestern University this fall. ■



CREDIT: NASA-JPL

EUROPA MISSION

GIVES UNDERGRADS A JUMPSTART INTO RESEARCH

NASA is gearing up for a mission to land on Jupiter's moon Europa, which houses a deep ocean beneath an icy shell. This mission, which could seek evidence of life on an icy world, is one of a kind, and it's also created a unique opportunity for ASE/EM students. Several undergraduate students have gotten a chance to work on the Europa lander project, mostly focusing on computational simulations. For many of these students, working at NASA's Jet Propulsion Laboratory is a childhood dream come true. And it's also a chance to get some early professional experience, participate in cutting-edge research and inform their future career choices. Professor David Goldstein, along with professor Philip Varghese and Laurence Trafton, a senior research scientist from UT's Department of Astronomy, are advising the students and helped them connect with JPL. ■

Learn more about the students and their experiences working at JPL
bit.ly/EuropaUG

'SPACE WILL SOON BE A PLACE WHERE PEOPLE LIVE AND WORK'

Earlier this year, **Blue Origin** — the spaceflight company formed by Amazon founder Jeff Bezos in 2000 — successfully launched its first-ever crewed mission, taking another major step forward in its mission to lower the cost of access to space through reusable spacecraft and rocket engines. For UT alumnus and Blue Origin CEO Bob Smith, the company's mission represents a full-circle opportunity to provide a new generation with the same inspiration he received from earlier aerospace accomplishments.

"I went straight into aerospace engineering as an undergraduate and I can't even explain why, other than the fact that, like many people of my generation, I was really inspired by Apollo," Smith said. "My father was a pilot during the Korean War, and I think that love of flying, amplified by Apollo, was a large contributor to my interest and passion for this field. So it was never a choice for me — I have always wanted to be in the space industry."

After earning his bachelor's degree from Texas A&M University, master's degree from Brown University and Ph.D. from UT Austin, Smith served for eight years at The Aerospace Corporation in a variety of roles, working on launch vehicles and some of the first GPS satellites before becoming the corporation's director of NASA Programs. He then led several NASA Shuttle Upgrades Program at United Space Alliance for five years before spending 13 years at Honeywell Aerospace as chief technology officer and, ultimately, as president of the mechanical systems and components division.

"The variety of my career experience has been really valuable for me because I first got to work for a federal research center, then went on to a government contractor and finally a large commercial aerospace business," Smith said. "So, having that depth and breadth of business and technical experience gave me a good leadership foundation before coming to Blue Origin." In describing his excitement about leading Blue Origin, Smith notes that his mother said it best when she pointed out, "This is the job that 12-year-old Bobby would have wanted!" His passion for Blue Origin's mission is certainly palpable as he discusses the company's efforts to get to orbit easily, inexpensively and frequently.

"Once you get to orbit, you're halfway to anywhere,"

Smith said. "NASA's shuttle program was on the right track in terms of promoting the idea that reusable spacecraft was the path that needed to be taken. Companies like Blue Origin are standing on the shoulders of those incredible accomplishments from decades ago, and now it's our responsibility to build the infrastructure and sustainable capabilities that get us into orbit on a regular basis."

New Glenn, named after astronaut John Glenn, represents Blue Origin's next big step. With fully reusable components that allow the vehicle to be cost-competitive and highly available without sacrificing reliability, New Glenn will make orbital spaceflight both safer and more efficient. Its debut launch is set for next year. "Space will stop being as exotic as it has been — it will still be a remarkable place, but it will actually become a destination," Smith said. "It will be a place where people live and work, and not only those who are sponsored by governments. Becoming an astronaut to get to space will be unnecessary." ■

"ONCE YOU GET TO ORBIT, YOU'RE HALFWAY TO ANYWHERE. NASA'S SHUTTLE PROGRAM WAS ON THE RIGHT TRACK IN TERMS OF PROMOTING THE IDEA THAT REUSABLE SPACECRAFT WAS THE PATH THAT NEEDED TO BE TAKEN. COMPANIES LIKE BLUE ORIGIN ARE STANDING ON THE SHOULDERS OF THOSE INCREDIBLE ACCOMPLISHMENTS FROM DECADES AGO."



— BOB SMITH, CEO BLUE ORIGIN AND 1991 ASE PHD ALUMNUS



DAVID FRIDOVICH-KEIL

David Fridovich-Keil joins us as an assistant professor this fall. His research spans optimal control, dynamic game theory, learning for control and robot safety. While he has also worked on problems in distributed control, reinforcement learning and active search, he is currently investigating the role of dynamic game theory in multi-agent interactive settings such as traffic. Fridovich-Keil's work also focuses on the interplay between machine learning and classical ideas from robust, adaptive and geometric control theory.

Fridovich-Keil received his doctorate from the University of California, Berkeley, where he developed some of the first efficient techniques for solving noncooperative, game-theoretic motion planning problems. During his graduate studies, Fridovich-Keil briefly worked at the self-driving car company Nuro. His postdoctoral research focused on exploiting computational parallelism in stochastic optimal control problems.

WHAT ATTRACTED YOU TO TEXAS ASE/EM?

I've heard wonderful things about living Austin, so it's been on my radar for a while now. And since my research focuses on control theory and robotics, I was looking at schools where I knew there were strong programs in those areas. I also knew former students who had attended and they all had good things to say about their experience. When I interviewed, it was all virtual due to the pandemic, so I was only able to meet people on Zoom, but I really enjoyed talking with everyone I did meet with, and left with a very positive impression. I'd say the last that thing is that UT and Austin felt very familiar to me. I grew up in Atlanta, so it's still generally in the southern U.S. Basically, ASE/EM checked all the boxes for what I was looking for, and I am happy to join the department.

WHAT DO YOU ENJOY MOST ABOUT YOUR RESEARCH?

I think the thing that I like most is that I find it very easy to straddle this divide between doing something that's intellectually interesting and subtle, and at the same time also very, very practical. I originally became interested in



Check out his recent invited talk at the RSS 2021 Workshop on Perception and Control for Autonomous Navigation in Crowded, Dynamic Environments on YouTube

youtu.be/EmrReoNQP3s

multi-agent interaction and game theory while working at a car company. It really doesn't get more practical than asking a question like, "Would I want to sit in this car?" and it's very intuitive to think about the fact that almost everyone drives a car, and then put myself in a driving scenario. For example, thinking about how I might react to a certain type of oncoming car at an intersection, or whether I drive in a reasonable way. This area of research isn't just purely experimental and it's not truly theoretical – I think there are elements of both, and that excites me.

TELL US ABOUT YOUR TEACHING PHILOSOPHY.

I really like to provide project-based learning for both undergraduate and graduate courses. I especially think it's important to include projects in graduate courses — something that students might be able to turn into a future research project — so I try to provide opportunities for that as well. The other thing I try to be aware of is if students are asking the same question multiple times, chances are, it means there is a better way to explain it. Also, being aware that students come into some courses with very different backgrounds and skill sets. Because of this, I think it's a very good idea to design a course with different parts that will be familiar to a variety of students.

HOW DO YOU LIKE TO SPEND YOUR FREE TIME?

Outside! I like hiking, cycling and just walking around the neighborhood. A few years ago, I got into frisbee golf, so I was really excited to see how many courses there are in this area. Other than that, I like to read fiction and play acoustic guitar. ■

ASE/EM ACADEMY OF

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2021
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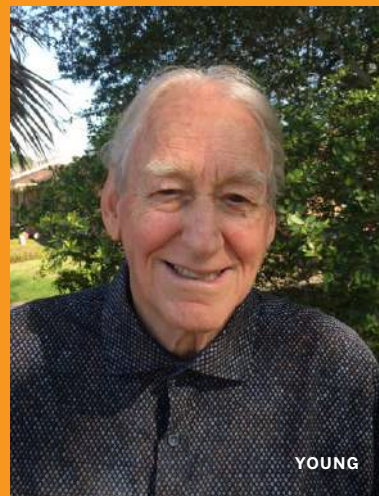
JU



MEYERS



SCHMISEUR



YOUNG

DISTINGUISHED ALUMNI

Eight alumni of the Department of Aerospace Engineering and Engineering Mechanics at The University of Texas at Austin have been elected to the 2021 class of the ASE/EM Academy of Distinguished Alumni.

The Academy was established in 2019 with the vision to foster excellence within the aerospace engineering, engineering mechanics and computational engineering programs in Texas ASE/EM through recognition, participation, encouragement and support of the department.

Members are honored by the Academy for their outstanding technical contributions to their fields, excellence in leadership and dedication to improving our community. These distinguished alumni include professors, entrepreneurs, government and industry leaders, astronauts, pilots, researchers and more. Learn about the ASE/EM Academy of Distinguished Alumni at ae.utexas.edu/alumni/ada

THE MEMBERS ELECTED TO THE ASE/EM ACADEMY OF DISTINGUISHED ALUMNI FOR 2021 ARE:

MANLEY C. BUTLER, JR.

Founder/President, Butler Parachute Systems, Inc.

STEPHEN P. (PAT) CONDON

Major General, USAF (*Retired*)

ESTEVAN "STEVE" DELEON

Co-Founder, Senior Partner & VP of Engineering, Pecos Country Energy and Exploration Co.; Aeronautical Engineer Senior Staff, Mass Properties Group, F-22, Lockheed Martin (*Retired*)

LISA GUERRA

Senior Technical Advisor, Office of the Administrator, NASA

G. T. JU

General Manager of Deepwater Projects and Engineering, Shell International Exploration & Production, Inc. (*Retired*)

JILL R. MEYERS

Senior Manager, National Radio Astronomy Observatory

JOHN D. SCHMISSEUR

H.H. Arnold Chair and Goethert Professor, The University of Tennessee Space Institute

KENNETH "KEN" ALDEN YOUNG

Aerospace Engineer, NASA/Contractors (*Retired*)

A virtual recognition event was held to honor these new members this April due to the ongoing pandemic, with an in-person event to be scheduled in the near future.

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HOW WAS YOUR SUMMER?

We love hearing from our students over the summer months while they are gaining valuable hands-on experience working as interns at various companies and agencies across the country! **Y'all make us proud to call you Texas Engineers.**

Follow us on Instagram to learn more about our students' experiences: [instagram.com/utaerospace](https://www.instagram.com/utaerospace)

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