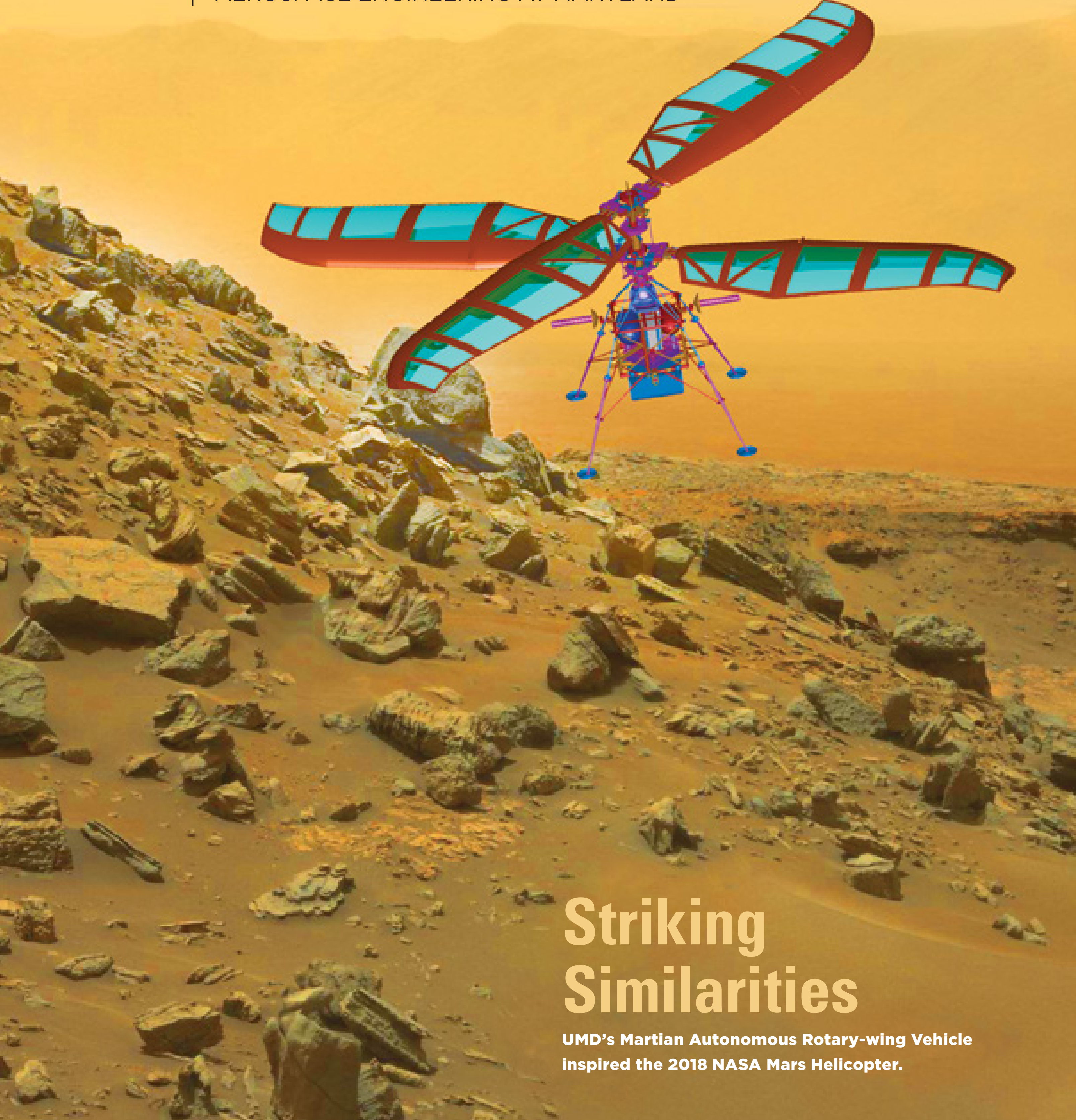
FALL 2018 | THE A. JAMES CLARK SCHOOL OF ENGINEERING

UNIVERSITY OF MARYLAND 1856

AEROCONTACT

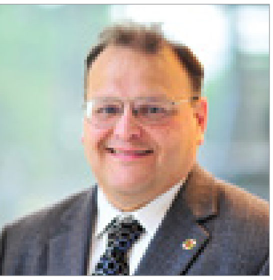
AEROSPACE ENGINEERING AT MARYLAND



Striking Similarities

UMD's Martian Autonomous Rotary-wing Vehicle inspired the 2018 NASA Mars Helicopter.

Chairman's Corner



A Record of Excellence

In May, when I read that NASA was planning to send a helicopter to Mars as part of its 2020 rover mission, I was delighted, but not surprised. For a long time, our department has had a strong relationship with the agency. Just look at the many projects related to space and aeronautics our students and faculty have been involved with over the years. It's no coincidence that the helicopter that is destined to fly on Mars will feature two-bladed coaxial rotors on a square fuselage. We can trace its inspiration back to the American Helicopter Society's 1999-2000 student design competition. A team of our graduate students (led by Anubhav Datta, now an associate professor in the department) won first place for their Martian Autonomous Rotary-wing Vehicle (MARV).

In addition to the MARV story, this issue includes a discussion about deployable heat shields, new research on hypersonic shock waves and boundary layers, the mapping of small orbital debris through plasma soliton detection, an innovative way to offload astronauts for more effective exploration, and the development of a vertical take-off and landing vehicle that will transport customers on demand.

The issue also features the undergraduate and graduate designs that won first-place in the Vertical Flight Society's annual competition. These top-prize recognitions expand our record of excellence at this competition—we also won first place in both the graduate and undergraduate categories last year, and we won the top award in the graduate category in 2016 and 2015.

Recognitions at the American Institute of Aeronautics and Astronautics Region 1 Student Conference are included as well. I was impressed by our attendance and performance at this year's event. Our students presented more than half of the papers (37 of 66) and won seven of the twelve awards.

We also applaud the team of 19 undergraduate students who excelled at the RASC-AL competition, winning first place for the theme category and second place overall.

Dr. Elaine Oran's induction into the American Academy of Arts and Sciences (highlighted in these pages) is truly a milestone to be celebrated.

We hope you enjoy the issue. I extend my sincere thanks to you for your steadfast support and engagement.

Norman M. Wereley
MINTA MARTIN PROFESSOR AND CHAIR
DEPARTMENT OF AEROSPACE ENGINEERING

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Mars landscape courtesy NASA

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Please send letters to the editor and alumni notes to aeroalumni@umd.edu

Distance and Time On average, Mars is about 140 million miles from Earth. From red to blue planet (or vice versa), a beam of light takes over 12 minutes at that distance. It took 11 months for Viking 1 to touch down on Martian soil. It's landing on July 20, 1976 was a first for a U.S. spacecraft.

Given the distance, so much continues to be at stake in the mission of getting there and exploring. In May, the National Aeronautics and Space Administration (NASA) announced another rover mission. Only this one will include a helicopter.

"The Mars Helicopter, a small, autonomous rotorcraft, will travel with the agency's Mars 2020 rover mission, currently scheduled to launch in July 2020, to demonstrate the viability and potential of heavier-than-air vehicles on the red planet," the press release states.

Inspired by Design To understand the evolution of the undertaking, it might help to look at its inspiration. In 1999, the American Helicopter Society (AHS) announced its 17th annual student design competition. Sponsored by AHS, NASA and Sikorsky Aircraft, the competition for the year 2000 challenged university students to design an autonomous rotary wing vehicle for exploration of Mars.

The specifications called for a rotorcraft that could sustain controlled flight for a minimum of 30 minutes and have a range of at least 25 kilometers. The maximum mass of the vehicle was to be no greater than 50 kilograms. The student teams could choose to submit a design for one or more of the following: vehicle design, propulsion system design, or flight control system design.

A team of graduate students from UMD's Alfred Gessow Rotorcraft Center (AGRC) participated in the vehicle design part of the contest. According to Distinguished Professor Inderjit Chopra, who was one of the faculty advisors, it was an ambitious project. "Because of the low atmospheric density on Mars, the geometry and the airfoils for the co-axial rotors required a lot of thought and development," ecalls Chopra, who is the director of AGRC.

But it was well worth the effort. UMD's team won the contest for designing what they called the Martian Autonomous Rotary-wing Vehicle (MARV). The design accounted for large variations in daily temperature, low gravity, low atmospheric density, and low oxygen levels. Low gravity on Mars means that for the same vehicle mass, weight is one-third of that on Earth. Atmospheric density on Mars is about one-hundredth of that on Earth. With an atmospheric pressure of 0.0078 of that on Earth, Mars has only 0.13% oxygen in its atmosphere. All of this had to be factored into the design.

According to Associate Professor Anubhav Datta who led the design team as a graduate student, the MARV design was an instrumental first step in the larger design scope. It "generated the first serious detailed designs" for vertical flight in the Martian atmosphere, he told the Vertical Flight Society.

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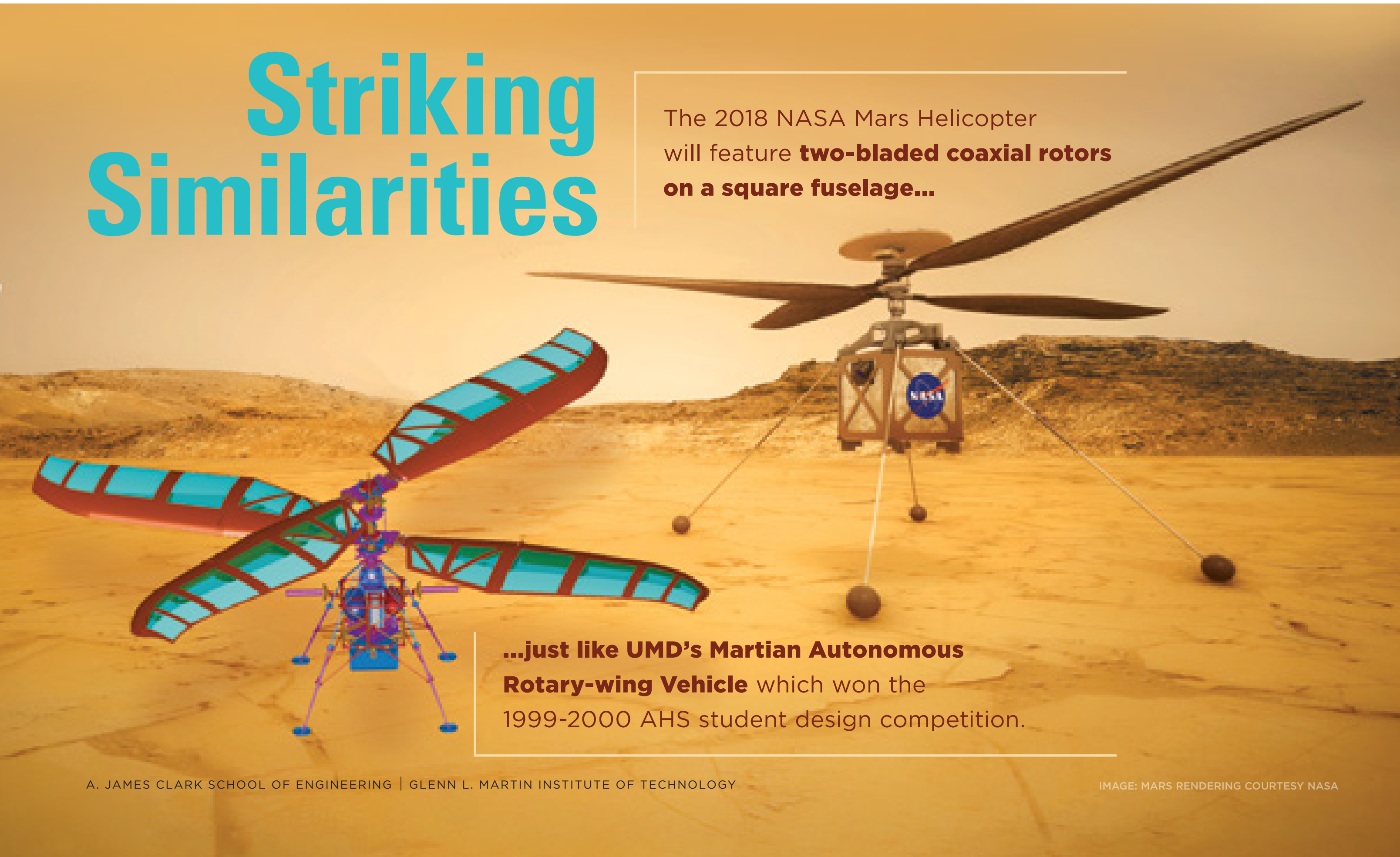
Striking Similarities

The 2018 NASA Mars Helicopter will feature **two-bladed coaxial rotors on a square fuselage...**



...just like UMD's Martian Autonomous Rotary-wing Vehicle which won the 1999-2000 AHS student design competition.

IMAGE: MARS RENDERING COURTESY NASA

"The ability to see clearly what lies beyond the next hill is crucial for future explorers."

THOMAS ZURBUCHEN
ASSOCIATE ADMINISTRATOR, NASA

Major Considerations Of course, another big factor that had to be considered in the student design project was speed. The ratio of air density to its viscosity, or the Reynolds number, had to be taken into account. For the same speed and characteristic dimensions, the Reynolds number on Mars is 0.019 times of that on Earth, and the Mach number is 0.7 times of that on Earth.

Carbon dioxide comprises about 95 percent of the atmosphere on Mars, and because the atmosphere is so thin, the planet is not able to retain heat energy. The days are warmer than the nights, but, compared to Earth, Mars is very cold. Temperatures average about 80 degrees below Fahrenheit (or minus 60 degrees Celsius). For UMD's student design team, these conditions presented challenges as well as opportunities to design an innovative airframe and power plant.

For the vehicle to operate on Mars, the team had to accommodate the low Reynolds number and high subsonic Mach number, which meant the geometry and the airfoils for the co-axial rotors had to be just right. They determined that power would come from a proton exchange membrane fuel cell power plant, which would use hydrogen and oxygen as fuel.

The team also had to think about how MARV would be stored during its trip to Mars. They decided that the rotor blades had to be capable of being folded at two stations, allowing for compact storage. On Mars, the blades would self-deploy and snap into place, keeping their extended position. The landing gear would also be retractable to reduce storage space.

Light and Strong Although the size and weight of UMD's MARV and the 2018 NASA Mars Helicopter are different, the similarities are evident. Both have two-bladed coaxial rotors on a square fuselage. The 2018 NASA Mars Helicopter is just under 4 pounds (1.8 kilograms) and its fuselage is about the size of a softball. Its two counter-rotating blades are designed to spin at almost 3,000 revolutions per minute, or about 10 times the rate of a helicopter on Earth.

"The altitude record for a helicopter flying here on Earth is about 40,000 feet," said Mimi Aung, the Mars Helicopter project manager at NASA's Jet Propulsion Laboratory. "The atmosphere of Mars is only one percent that of Earth, so when our helicopter is on the Martian surface, it's already at the Earth equivalent of 100,000 feet up. To make it fly at that low atmospheric density, we had to scrutinize everything, make it as light as possible while being as strong and as powerful as it can possibly be."

The 2018 NASA Mars Helicopter contains built-in operational capabilities, including solar cells to charge its lithium-ion batteries, and a heating mechanism to keep it warm through cold nights. During the voyage, the helicopter will be stowed inside a rover. When the rover reaches the surface of Mars, it will find a good location to deploy the helicopter and place it on the ground.

Flight Objectives The helicopter's first flight will be a basic one, where it climbs to 10 feet and hovers for about 30 seconds. Subsequent tests will include up to five flights of incrementally farther flight distances, up to a few hundred meters, and longer durations as long as 90 seconds.

The helicopter's primary mission is to demonstrate that it can fly on Mars, maintain controlled flight and send pictures back to Earth. If it does, it will be the first time any country has done this on any celestial body. As part of NASA's 2020 rover mission, it is scheduled to begin its journey to the red planet in July 2020 and is expected to arrive there in February 2021.

"The ability to see clearly what lies beyond the next hill is crucial for future explorers," said Thomas Zurbuchen, Associate Administrator for NASA's Science Mission Directorate at the agency headquarters in Washington. "We already have great views of Mars from the surface as well as from orbit. With the added dimension of a bird's-eye view from a 'marscopter,' we can only imagine what future missions will achieve."

Accelerating Deceleration

How one student's message captured the attention of a multi-billion dollar company.

On April 15th, Elon Musk tweeted that "SpaceX will try to bring rocket upper stage back from orbital velocity using a giant party balloon." The tweet caught the attention of Quinn Kupec, an undergraduate researcher, who enthusiastically tweeted back the following: "If you're proposing what I think you are, an ultra low ballistic entry coefficient decelerator, then you and @SpaceX should come see what we have at the @UofMaryland. We've been working on this for awhile and just finished some testing."

Quinn never expected a reply, but Musk soon tweeted this back: "Yeah, exactly! Would be great to hear your thoughts. We're going to try a few approaches. Can def be done, just about minimizing mass."

The following question and answer session covers Quinn's research on a deployable heat shields (or ParaShields), which can accommodate high aspect ratio payloads, provide more drag, and reduce heating around a spacecraft. Quinn also discusses future work and his conversation with the SpaceX staff.

THE FOLLOWING IS A QUESTION AND ANSWER SESSION WITH QUINN KUPEC, WHO RECENTLY GRABBED THE ATTENTION OF ELON MUSK.

Q: Can you describe your research as it relates to your topic, Testing Aerodynamic Stability of Parashield Reentry Vehicles in Low Mach Number Flight?

A: Deployable heat shields are super useful. You can do a whole lot with them. They're really nice in the upper atmosphere because they slow down a spacecraft, so there's less heating. There are a whole bunch of technical benefits. Our project is fairly easy and tests something that still isn't super well-defined. We send [the deployable heat shield] up on a balloon and we have our center of gravity offset behind our center of drag, just by nature of how the craft is designed, and then we see how stable it is.

(CONT. ON PAGE 4)

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Q: Who would benefit from a deployable heat shield? Or who should care about your project?

A: Anybody doing space exploration should definitely care because it's super useful. Dr. Akin has a paper about the application of these things and why they're so great. So upper stages of rockets, for example, could be recovered, theoretically. Crew rotations from the international space station would be more efficient. Right now, when you recover your crew or your cargo, you bring them back in a very traditional looking space capsule; it's looked the same since space capsules were invented: a sphere on the bottom and a tapering cone towards the top. But cones are really a terrible shape to put people in; it doesn't make a whole lot of sense. You lose all this space at the top and have your people crammed in at the bottom.

Cylinders, on the other hand, are a lot better. You can have a lot more space in a cylinder because it's not tapering away. But the problem with cylinders for a conventional entry vehicle is aerodynamic impingement. Basically, when the air flows around the heat shield, it moves outward and then back in towards your spacecraft. Spacecrafts are cone-shaped so that when the air comes back in, it's past the edge of the craft. If air hits the craft when it moves back in, it creates a lot of heat. Heating is the biggest problem for a craft entering the atmosphere. So then you need a thermal protection systems and those are really heavy, and heavy things are bad for a spacecraft. But if you have a really big heat shield at the bottom, the air closes farther back and your cylinder is fine: it's well within the protected area. This makes it a lot more effective to use when bringing things back from space. If you want to bring crew members back, you can fit a lot more crew; if you want to bring stuff back, you can fit a lot more stuff."

Q: Can you provide a summary of the overall concept? There is TARDIS-1 and TARDIS-2 and then SHIELD, right?

A: TARDIS-1 (Triggered Aerodynamic Resistance and Drag by Increase in Surface) started off as a pitch for our freshman project [in ENAE100], and I started working on it right away, even during that first semester in my spare time. At that point, it was all just concepts on my computer. Since I'd seen [NASA] doing testing with Orion, I thought, let's try to build it into a spacecraft that already exists. So that's why [TARDIS-1] was spherical in shape because Orion had a spherical heat shield.

We ran a proof of concept test, deploying the heat shield from the balloon, and everything functioned as it should. After more leg work and research, we realized that the spherical section may not be such a great idea because it doesn't provide a lot of drag to slow down the descent. The whole point of these deployable heat shields is to change your ballistic coefficient. So if you increase your area and increase your coefficient of drag, your ballistic coefficient goes down, which is good. So if we're looking to have a larger area and a higher coefficient of drag, spheres are not so great because at a certain point the sphere begins to curve back around and its diameter is reducing. So you can either use a really big sphere, or you can use what's called a blended sphere cone. Most of the Mars entry vehicles' heat shields are blended sphere cones because the atmosphere is thinner, so you want a larger, flatter heat shield. So we tried that for TARDIS-2.

Last year, we took part in this competition called CanSat, a glider competition. UMD's team didn't place top forty, which meant we didn't get invited to the actual competition. But this year's competition will focus on a planetary entry vehicle and needs to deploy an aerodynamic decelerator as soon as it exits the rocket. We quickly put together a team, which was primarily people working on TARDIS, and now we're working on that. There were some changes we had to make for the competition and that's how we got to SHIELD, or the Simulated Heat Inhibiting Entry and Landing Device. We haven't done any testing with [SHIELD] yet. We will do a major balloon flight test. Eventually, we will be test-flying it on a small, suborbital rocket at 700 meters.

Q: What inspired your tweet to Elon Musk? Do you understand what he is envisioning?

A: I'd just come back from the [American Institute of Aeronautics and Astronautics] Region 1 Student Paper Conference in Potsdam, New York, where I presented about this. I was on Twitter when I saw his tweet and thought, wait a minute: By a "balloon" he means an inflatable, and by "inflatable" he means an inflatable heatshield. A lot of groups who do work with deployable heat shields, like NASA, use an inflatable structure. For us, it's just not practical. Ironically, having inflatable structures on balloons is really hard. Also, the math and risk analysis that Dr. Akin has done suggest that mechanical is better anyway; you don't save a lot of mass having an inflatable heatshield compared to mechanically actuated one, but you do have a high risk of it popping.

I thought that if [Musk] was actually talking about an inflatable heat shield, that's pretty similar to what we do. So I tweeted at him for fun.

So over the next day, I was getting a lot of likes on my tweet and I wondered if I could get enough likes that he might actually see it. So I got a lot of friends to like my tweet. It had been close to twenty-four hours since I'd tweeted it and I thought he wasn't going to tweet back. But then I got a [message] from my friend with a screenshot of Elon's response. I was just so shocked and excited. Especially because he wants to hear my ideas. I couldn't believe Elon Musk wanted to talk to me!

Q: Do you think some of the SpaceX staff would be interested in a partnership?

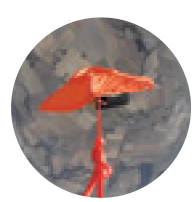
A: We set up a meeting with SpaceX [and their VP of Vehicle Engineering] and I brought in the SHIELD team and Dr. Akin and we talked for close to an hour about what we're doing and what they're doing. Toward the end, Mark Juncosa said it was really cool and said depending on where they decide to go with this, maybe they can partner with us and develop some stuff. So we'll see!

Q: How far along is this research, is it still conceptual or fundamental, or is it very close to being ready to be applied and rolled out?

A: [The inflatable heat shield] is possible now. It's going to be a pain to implement because there's a lot of engineering constraints with trying to attach a heat shield to an upper stage, the center of mass being a big one. There's also been speculation that he was actually talking about a 'ballute,' which is a balloon-parachute. It's sort of like an inflatable heat shield; it does the same thing: it drops your ballistic entry coefficient but it trails behind the payload as an inflatable balloon. But Dr. Akin and I were encouraging them to stick with heat shields; there's much more work that's been done on them. Ballutes can pop or your engine can still get scorched.

This is very much what SpaceX does; they try crazy things. A few years ago, if someone had said this was going to be a thing, I would have said, 'Yeah, okay, whatever.' But then again, several years before that, if someone had said they're going to land the first stage of an orbital class rocket booster on a drone ship in the middle of the Atlantic Ocean, that would have also been total insanity. And yet, here they are doing that. You look at where we were in the early 1900s. By the end of the 1960s, we had a man on the moon. Within 50 years or so we went from people not being able to fly to landing on another body. Aerospace is this really cool thing where stuff just happens superfast.

I think this is something where the technology is there, and it works—and we just need to figure out how to implement it. I think that if this is something [SpaceX] wants to do, we could see it within the next two to three years.



Elaine Oran Elected to American Academy of Arts and Sciences

PHOTO: AL SANTOS

A. James Clark Distinguished Chair Elaine Oran was inducted into the American Academy of Arts and Sciences in recognition of her outstanding accomplishments in the unification of engineering, scientific, and mathematical disciplines into a computational methodology to solve challenging and unique aerospace combustion problems.

Founded in 1780, the American Academy of Arts and Sciences purpose is "to cultivate every art and science which may tend to advance the interest, honor, dignity and happiness of a free, independent and virtuous people." Its strength lies in the intellectual leadership of its members and the wide range of expertise they bring to its studies and publications. Academy membership encompasses over 4,600 Fellows and 600 Foreign Honorary Members and reflects the full range of disciplines and professions: mathematics, the physical and biological sciences, medicine, the social sciences and humanities, business, government, public affairs, and the arts.

"Most scientists and engineers are intelligent and curious," recognizes Oran. "Truly significant inventions or discoveries require curiosity, determination, persistence, and a dose of serendipity, usually going against established procedures or advice."

Widely recognized for her contributions to the advancement of science and engineering, Oran's research includes work on chemically reactive flows, turbulence, numerical analysis, high-performance computing and parallel architectures, shocks and shock interactions, rarefied gases, and microfluidics, with applications to combustion, propulsion, astrophysical explosions, and micro-sensor design.

Oran is a member of the National Academy of Engineering, one of the highest honors to which an aerospace engineer can aspire. She is also an Honorary Fellow of the American Institute of Aeronautics and Astronautics, the highest distinction conferred by AIAA, recognizing preeminent individuals who have had long and highly contributory careers in aerospace and who embody the highest possible standards in aeronautics and astronautics.

"I enjoy figuring things out, little things, that eventually all seem to add up to something substantial...some new idea, some new capability, some new pieces of information about how the pieces of a complicated physical system work and fit together," Oran adds.

Oran is also a fellow of several societies including the American Society of Mechanical Engineers (ASME), the Society of Industrial and Applied Mathematics (SIAM), the American Physical Society (APS), and the Combustion Institute. Oran has published hundreds of journal articles, numerous book chapters, and has delivered over 250 invited presentations.

"From fire whirls to blue whirls and combustion with reduced pollution," a paper Oran, Affiliate Associate Professor Michael Gollner, and Research Scientist Huahua Xiao published a few years ago in the peer-reviewed journal *Proceedings of the National Academy of Sciences*, garnered a great deal of attention for describing a new type of fire tornado called the "blue whirl," which could lead to beneficial new approaches to energy production, reduced carbon emissions, and improved oil spill cleanup.

"Membership in the academy is not only an honor, but also an opportunity and a responsibility," says Jonathan Fanton, president of the American Academy. "Members can be inspired and engaged by connecting with one another and through academy projects dedicated to the common good. The intellect, creativity, and commitment of the 2018 class will enrich the work of the academy and the world in which we live."

Among the Academy's Fellows are more than 250 Nobel laureates and 60 Pulitzer Prize winners.

Visionary Ideas Rewarded

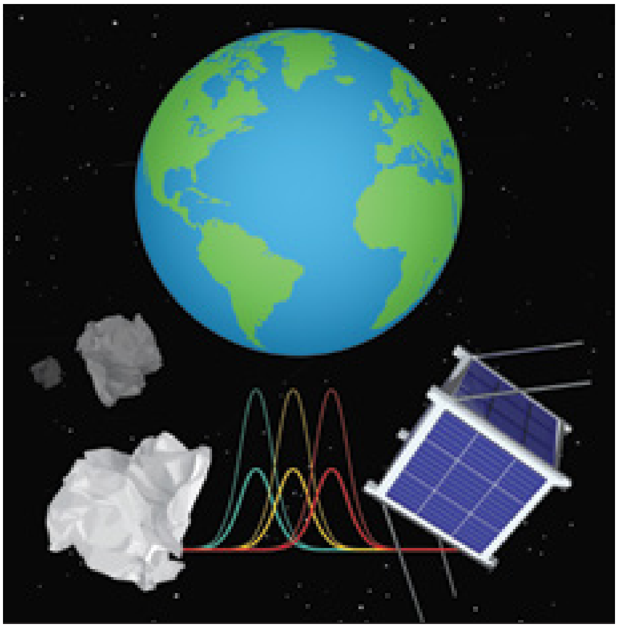
NASA'S INNOVATIVE ADVANCED CONCEPTS PROGRAM WELCOMES TWO UMD PROJECTS

In the spring, Assistant Professor Christine Hartzell and Associate Professor Dave Akin received news that their proposals were accepted for the 2018 Phase 1 Program under the National Aeronautics and Space Administration (NASA) Innovative Advanced Concepts Program (NIAC).

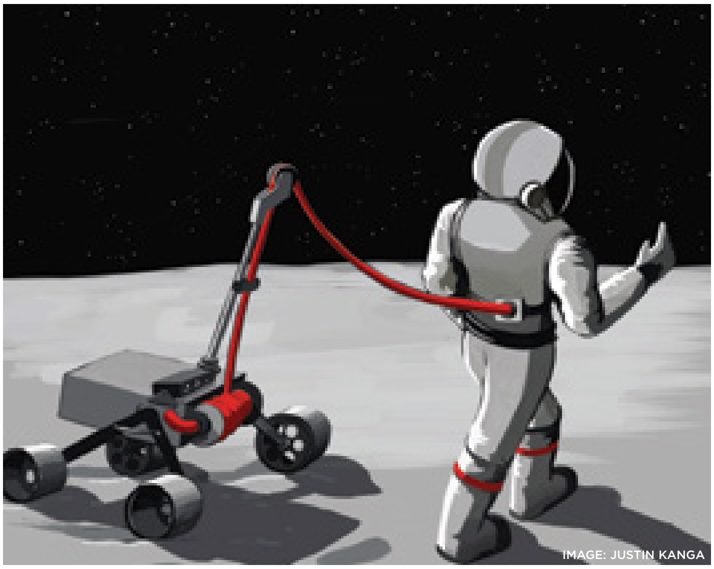
Hartzell proposed to evaluate the feasibility of mapping small (micron to sub-cm scale) orbital debris about Earth using a fleet of cubesats equipped with sensors to detect the plasma signature of the debris. Some of the benefits include the mapping of hazardous and currently undetectable orbital debris and enabling real-time evaluation of mitigation efforts.

"I am very happy that my proposal has been selected," Hartzell said. "This is a great opportunity to evaluate the feasibility of mapping of small orbital debris through plasma soliton detection."

Akin's proposal, "BioBot: Innovative Offloading of Astronauts for More Effective Exploration," recognized that extravehicular activity performance in gravitational environments is strongly affected by the weight of the suit and backpack, and that by removing the portable life support system and having it carried by a robot that follows the astronaut and handles the umbilical, weight on the crew is cut by more than half and suit center of gravity closely conforms to the body's center of gravity.



Mapping orbital debris.



An innovative way to offload astronauts to improve exploration.

"I have found NIAC to be among the most competitive of NASA research programs, so I was delighted when I heard my proposal had been accepted," Akin said. "The Space Systems Laboratory has a long history of investigating ways for humans and robots to work together in space, and this will let us explore a new paradigm for the human exploration of the moon and Mars."

The NIAC Program aims to nurture visionary ideas that could transform future NASA missions with the creation of breakthroughs—radically better or entirely new aerospace concepts—while engaging America's innovators and entrepreneurs as partners in the journey. The program seeks innovations from diverse and non-traditional sources and NIAC projects study innovative, technically credible, advanced concepts that could one day "change the possible" in aerospace.

» **FOR MORE INFORMATION, VISIT**
https://go.umd.edu/nasa-niac

ON THE RECORD

Paley Explains Technology Inspired by Nature on WYPR's 'On the Record


PHOTO: AL SANTOS

In March, Professor Derek Paley was a guest on the public radio show, "On the Record," produced by WYPR. The show, titled "Technology Inspired by Nature," explored how researchers are incorporating the abilities of insects, birds, fish, and animals to improve robots. "We're looking at how fish sensory systems operate and how we can endow our submarines, our unmanned vehicles, with the same type of ability to perceive the fluidic environment nearby," he said. Paley went on to discuss why scientists often look to nature for answers and described his research.

» TO HEAR THE INTERVIEW, VISIT: https://go.umd.edu/paley-wypr

Hopping Over Traffic

JOINT PROJECT AIMS TO DESIGN AN AIR TAXI THAT COULD "HOP" FROM BALTIMORE TO D.C. IN 15 MINUTES.

A new collaboration between Lusby, Maryland-based HopFlyt Corporation and Assistant Professor Huan Xu seeks to reduce commuting time and traffic with the development of an air vehicle that aims to "hop" over traffic for distances up to 30 miles, carrying up to three passengers at a time.

The new project envisions reducing the 90-minute drive from Baltimore to Washington, D.C. during rush hour to just 15 minutes. The highly autonomous but piloted vehicle, called the Venturi, will take off and land like a helicopter and fly like an airplane, according to HopFlyt CEO and Chief Design Engineer Rob Winston. "Our plan is to use it as an on-demand vertical take-off and landing (VTOL) vehicle. People could schedule a flight similar to a service such as Uber."

The Venturi is all-electric, with 16 motors that adjust to make flight smooth for passengers. It gains efficiency, Winston explained, by eliminating control surfaces such as the hinged part of a wing used to provide balance. Instead, the Venturi will tilt its wings and adjust power in its motors to steady its flight.

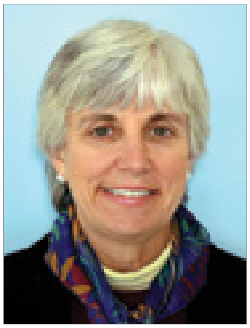
That's where Xu comes in. "We are working on the control laws for how you model this," she explained. "We are coming at it from a theoretical modeling perspective—this should be this length, this motor should be this fast, so it is as safe as possible for people. I am excited to be working on this project and eventually see this type of technology transition to the public."

Xu's project with HopFlyt is supported by $100,000 in joint funding from the Maryland Industrial Partnerships (MIPS) program, an initiative of the Maryland Technology Enterprise Institute (Mtech) in the A. James Clark School of Engineering, and the company. MIPS supports technology development projects that team Maryland companies with University System of Maryland faculty.

HopFlyt also received a $25,000 pre-seed investment through the Technology Development Corporation (TEDCO) Rural Business Innovation Initiative.

Flatau Recognized as Distinguished Lecturer

Professor Alison Flatau has been named a 2018 Distinguished Lecturer by the IEEE Magnetics Society. She was recognized for



her insights and teaching on the topic of "Structural Magnetostrictive Alloys: From Flexible Sensors to Energy Harvesters and Magnetically Controlled Auxetics."

According to Flatau, novel sensors and energy harvesting transducers take advantage of the significantly expanded design space made possible by recent advances in structural magnetostrictive alloys. These alloys can be machined and welded, have high fracture toughness, and can actuate, sense, and carry load while subjected to tension, compression, and bending. Her talk on this topic includes an introduction to magnetostrictive materials and transduction, and a discussion on the use of low-cost rolling and annealing methods in lieu of more costly crystal growth methods for making bulk iron-gallium (Galfenol) and iron-aluminum (Alfenol) alloys.

Employing sensors and energy harvesting devices as examples, Flatau explains and demonstrates the process of using magnetostrictive materials to convert mechanical energy into magnetic energy and then into electrical energy. Examples of magnetostrictive devices include prototypes ranging in size from nanowire-based pressure sensors to huge structures floating in the ocean that convert wave energy into electrical power for "community-scale" energy needs.

CADOU AND YU RISE TO PROFESSOR

CHRISTOPHER CADOU was promoted to the rank of professor. A Keystone Professor, Cadou is pursuing research in the area of combustion (micro and conventional scales), laser diagnostics (conventional and micro), compact power systems, and fuel cells.

KENNETH YU was promoted to the rank of professor. Yu is engaged in research and scholarly work focused on active combustion control and supersonic mixing have made significant impact on developing enabling technologies for propulsion and power systems.

BAEDER BECOMES AHS TECHNICAL FELLOW

Professor James Baeder was named a Technical Fellow of the American Helicopter Society (AHS). AHS Technical Fellowships are granted to Society members whose career-based accomplishments towards the goals and objectives of the vertical flight community constitute an outstanding technical achievement.

Baeder has been a longtime contributor, scholar and leader at the Alfred Gessow Rotorcraft Center, with research interests in the areas of computational aerodynamics and aeroacoustics with specific interest in coupling computational fluid dynamics to comprehensive rotor analysis. Baeder has also led the Department of Aerospace Engineering's foray into wind energy research as thrust leader for wind energy in the University of Maryland Energy Research Center.

AIAA NAMES BAUCHAU FELLOW

The American Institute of Aeronautics and Astronautics (AIAA)

has promoted **OLIVIER BAUCHAU**, the Igor Sikorsky Distinguished Professor in Rotorcraft, to the rank of Fellow. Bauchau is conducting research in the fields of multibody dynamics, rotorcraft aeromechanical comprehensive modeling, structural dynamics, and composites materials and structures.

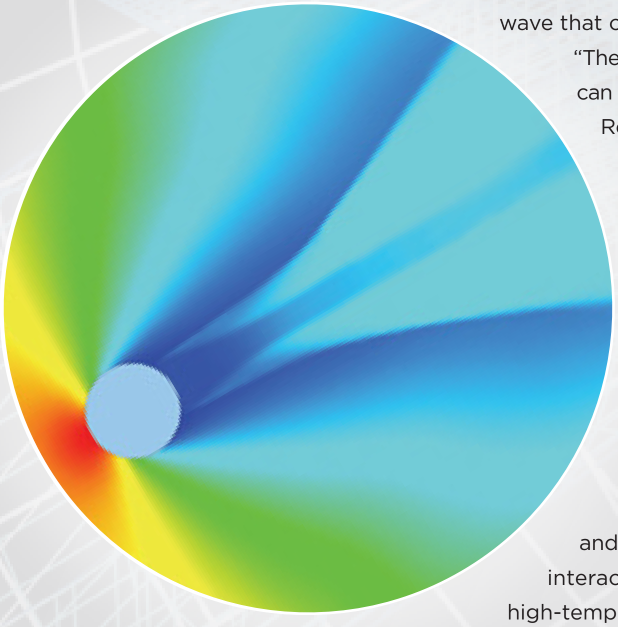
SHOCK WAVES AND BOUNDARY LAYERS

EXPLORING THE COMPLEXITIES OF HYPERSONIC FLIGHT.

What if you could fly over 1 mile per second? A trip from New York City to Los Angeles would take about 40 minutes rather 4.5 hours. You'd be flying at hypersonic speed, faster than a speeding bullet and more than five times the speed of sound. Imagine what this would mean for tourism, commerce, security and many other things.

The pursuit of hypersonic flight has been ongoing for decades, yet understanding the complex flow physics that occur at such high speeds continues to be a challenge.

Assistant Professor Stuart Laurence is currently conducting an experimental investigation of fluid-structure interaction problems that occur at hypersonic speeds. When a vehicle travels that fast, it generates a shock wave that causes air pressure, temperature, and density to rise quickly.



"The magnitudes of the changes in flow properties caused by shock waves can be tremendous," says Laurence, who recently won a Defense University Research Instrumentation Program (DURIP) Award to pursue work in this area. "At high enough hypersonic speeds, the energy in the flow behind the shock can even break apart the air molecules."

The increase is often so great that it produces extreme thermodynamic effects. A thin region near the surface of the vehicle known as the boundary layer, which may be only a few millimeters across, experiences very high temperatures, and the flow in this area can quickly change from a streamlined current along the front of the vehicle into a turbulent and chaotic state towards the back of it. This can lead to extreme mechanical and heating loads on the vehicle surfaces.

"My work involves examining the coupling between a flexible panel and the flowfield produced in a hypersonic shock wave/boundary layer interaction," Laurence says. The DURIP Award will fund completion of a high-temperature Ludwieg tube for the simulation of such hypersonic flows, as well as a schlieren flow visualization system.

The Ludwieg tube, a type of high-speed wind tunnel, uses electrical heating to produce hypersonic flow for short periods of time. The completed tunnel will include a dump tank, a nozzle and test section, and a 22-m long charge tube. The schlieren system will enable the visualization of important hypersonic flow features, including shock waves and boundary layers.

"A lot of our work focuses on using schlieren visualizations at very high frame rates—100,000 frames a second or faster—to obtain quantitative information about the unsteady flowfield," explains Laurence, who also won a Faculty Early Career Development Award this year from the National Science Foundation. The award will support research focused on the effects of thermal nonequilibrium on the acoustic noise radiated by a compressible turbulent boundary layer.

In high-speed flows, not only does turbulence within the boundary layer lead to extreme surface conditions, the turbulent motions can also cause the generation of intense, outward-propagating sound waves. The NSF-funded project aims to understand such noise generation when the gas in question (e.g., carbon dioxide, or high-temperature air) absorbs sound waves at certain frequencies because of the excitation of internal energy modes within the molecules.

John Anderson Scholarship Fund Supports Innovative Research

FUND FOSTERS DEEP LEARNING AND HANDS-ON EXPERIENCES ESSENTIAL TO STUDENTS' CAREERS

Imagine you're on a spacewalk to make a repair to your spacecraft. Inside the visor of your spacesuit, you see a number of projections that guide you along the way: oxygen tank levels, vital signs, and spacecraft system details. You reach out to fix the necessary components and it feels like your glove is barely there. You can move your fingers easily with surprising dexterity. The 3D visual interface and glove enable you to quickly and efficiently complete the repair and return to your spacecraft.

Now let's say you're back on Earth and you work for Amazon. Walking through the warehouse one day, you pass an aisle of package-delivery drones. Each has its own customized docking system for charging, and you start thinking about how docks could be designed for other free-flying robotic vehicles. Could the robots dock themselves? Could the docks store and send telemetric data?

The helmet visor display technology, exoskeleton for a spacesuit glove, and docking system for robotic vehicles are all examples of summer research projects supported by the John Anderson Scholarship Fund. Since 2008, this fund has encouraged innovation in the field of Aerospace Engineering by awarding one undergraduate student per year up to $3,000 to pursue experiential summer research. As the field increasingly prioritizes the need for both academic and hands-on learning, this opportunity is becoming especially valuable for students. Summer research allows students to delve into topics that interest them, bolstering their preparation for careers in industry and academia.

"This fund is so important," says Department of Aerospace Engineering Chair and Minta Martin Professor Norman Wereley. "It enriches the student experience, fostering amazing research endeavors in a concentrated period of time."

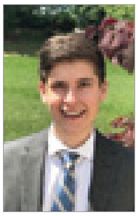
Dr. John D. Anderson, Jr. is a Professor Emeritus, a Glenn L. Martin Distinguished Professor in Aerospace Engineering, and a former Department of Aerospace Engineering Chair. Inducted into the National Academy of Engineering in 2010, Dr. Anderson serves as the Curator for Aerodynamics at the National Air and Space Museum of the Smithsonian Institution. He is the author of numerous textbooks on aerospace engineering and history and is admired for his contributions to hypersonic gas dynamics.

The scholarship recognizes students that demonstrate a dedication to the field, relentless drive, and desire to push the boundaries of current thought—all qualities that contributed to Dr. Anderson's own success. Through summer research, students exchange knowledge, test new ideas, and learn to overcome setbacks.

This endowed fund generates spendable income for one student project each semester. We ask for your help in growing the John Anderson Scholarship Fund endowment to support at least two student research projects per summer.

PLEASE CONSIDER MAKING A CONTRIBUTION TODAY AT https://aero.umd.edu/giving.

STEVEN NEUBAUER
2018 JOHN ANDERSON SCHOLAR



Steven Neubauer is the 2018 John Anderson Scholar. His research this past summer focused on the Naval Surface Warfare Center's new Extreme Power Internal Combustion engine.

JOHN ANDERSON SCHOLARSHIP RECIPIENTS

- **2018:** Steven Neubauer (B.S. AE '20)
- **2017:** Rosemary Davidson (B.S. AE '18)
- **2016:** Katelyn Melone (B.S. AE '18)
- **2015:** Ignacio Andreu (B.S. AE '16)
- **2014:** Lauren Trollinger (B.S. AE '15, M.S. AE '17)
- **2013:** Richard Young, III (B.S. AE '14)
- **2012:** Leah Sobel (B.S. AE '13)
- **2011:** Elishabet Lato (B.S. AE '12)
- **2010:** Marissa Intelisano (B.S. AE '10)
- **2009:** Breanne McNerney (B.S. AE '09) and Nicholas Woodside (B.S. AE '09)
- **2008:** Madeline Kirk Fosbury (B.S. AE '08)

» **FOR MORE INFORMATION, CONTACT Kendra Greenwaters at kendrag@umd.edu or 301-405-8642.**

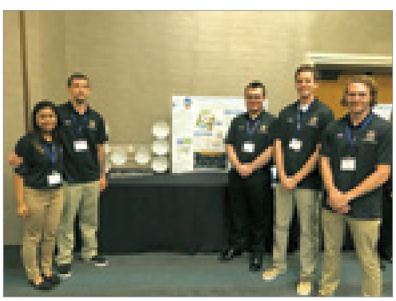
UMD RASC-AL Team Wins Big

A team of 19 undergraduate students in the Department of Aerospace Engineering were recently recognized at the Revolutionary Aerospace Systems Concepts–Academic Linkages (RASC-AL) Awards Ceremony in Cocoa Beach, Florida for designing a reusable hybrid propulsion stage that employs innovative combinations of operations and technology to improve on the current National Aeronautics and Space Administration (NASA) baseline in-space stage for transporting crew and cargo between cis-lunar space and the Mars system. This baseline is a hybrid concept consisting of a low-thrust Solar Electric Propulsion (SEP) system combined with a high-thrust chemical system.

The team, composed of all seniors from the Department of Aerospace Engineering's Space Systems Design course, won first place for the theme category and second place in the overall competition, which comes with a stipend to allow them to prepare and present a paper at the American Institute of Aeronautics and Astronautics (AIAA) SPACE and Astronautics Forum (2018 AIAA SPACE) in September.

THE TEAM WON FIRST PLACE FOR THE RASC-AL THEME CATEGORY AND SECOND PLACE IN THE OVERALL COMPETITION.

According to their competition paper, their design—called Trans-Mars Exploration Reusable Propulsion Stage (TERPS)—employs 4 chemical engines using unsymmetrical dimethylhydrazine and nitrogen tetroxide (UDMH/NTO), 12 nested Hall effect thrusters using xenon (Xe) propellant, and 8 solar thermal power systems with Gregorian concentrators. The power generation system will yield 750 kW throughout planned mission durations, 668 kW of which go to the solar electric propulsion system. The innovative solar thermal power generation system allows for versatility in payload capacity from 50t to 110t.



Members of the UMD team at the RASC-AL event in Cocoa Beach, Florida.

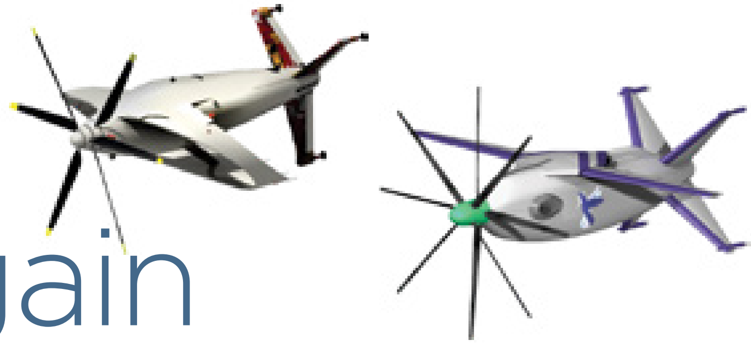
The team includes five sub-teams: Avionics, Flight Control, and Software (Brian Davis, Austin Mahowald, Ryan Quinn, and Robert Van Fleet); Load, Structures, and Mechanisms (Christopher Bernard, Logan Gibb, and Evan Peaco); Mission Planning and Analysis (Rosemary Davidson, Luke Renegar, and Mathew Vaughn); Power, Propulsion, and Thermal (Dylan Bell, Dylan DiBernardo, James McLaughlin, David Nestor, and Mandeep Sawhney); and Systems Integration (Karenna Buco, Joshua Curreri, Zane Gardenhour, and Nolan McMahon). The faculty advisors are Dr. David L. Akin, Dr. Andrew C. Becnel, Dr. Mary L. Bowden, and Dr. Jarred Young.

Dr. Akin, who attended the event, was also recognized at the Awards Ceremony. Akin, who is the Director of the University of Maryland's Space Systems Laboratory, won the Pioneering Exceptional Achievement Concept Honor (PEACH) Award for the most innovative and meaningful idea presented at the RASC-AL Forum. The PEACH award was established in honor of Lewis Peach, who contributed a great deal to space exploration, served as the chairman of the RASC-AL Steering Committee for more than a decade and was an inspirational leader and mentor.

RASC-AL projects allow students to incorporate their coursework into real aerospace design concepts and work together in a team environment. The competition is open to undergraduate and graduate university-level students studying fields with applications to human space exploration (for example, aerospace, bio-medical, electrical, and mechanical engineering; and life, physical, and computer sciences).

» FOR MORE INFORMATION ABOUT THE COMPETITION, VISIT rascal.nianet.org

Again and Again



UMD WINS VFS STUDENT DESIGN COMPETITION

The University of Maryland won first place in both the graduate and undergraduate categories of the 35th Annual Vertical Flight Society Student Design Competition. This marks the fourth consecutive year Maryland has won first place in the graduate category and the second consecutive year in the undergraduate category.

The graduate team's winning design, Metaltail, is an autonomous, coaxial-proprotor, swing-wing, tailsitter aircraft. The swing-wing design allows for efficient hover by decreasing download penalty when wings are swept back and excellent forward flight speeds when wings are straight like that of a fixed-wing aircraft. The adjustable sweep of the wings allows Metaltail to transition from hover to forward flight by reducing power during the maneuver. The aircraft is capable of hovering for over 2.5 hours, with a range up to 1240 kilometers, and can reach a top speed of 511 kilometers per hour.

The graduate team also won in the optional task of creating a FLIGHTLAB model for running rotorcraft analyses in the FLIGHTLAB flight simulation environment where judges can assess handling qualities and vehicle stability.

The undergraduate team's winning design, Kwatee, is a coaxial proprotor tail sitter configuration utilizing a novel variable incidence box wing to obtain an optimal angle of attack in various flying conditions and a bidirectional ducted fan for the efficient transition between flight modes. This radical design allows for two flight modes that enables Kwatee to hover to navigate a megacity. The aircraft has a forward flight capability to hover for 3.5 hours, a maximum dash speed of 426 kilometers per hour, and a range of 1,030 kilometers—all in a vehicle with a maximum gross takeoff weight of only 532.6 kilograms.

Advancing Excellence at AIAA Conference

More than half of the papers (37 of 66) that were presented at this year's American Institute of Aeronautics and Astronautics (AIAA) Region 1 Student Conference were from students at at UMD. Twelve students won awards for their papers, and seven were from UMD. These students include:

SKYLAR TRYTHALL: second place in the undergraduate division for his paper, "Laser Ablation Plume Impingement onto Spacecraft Materials." Professor Ray Sedwick is Trythall's faculty advisor.

WILLIAM V. WHITMORE: third place in the undergraduate division for his paper, "Tracking of Neutrally Buoyant Helium Bubbles in Low- Speed Flow with Motion Capture Cameras." Professor Jewel Barlow is Whitmore's faculty advisor.

SAIMOULI KATRAGADDA and **BENEDICT A. MONDAL**: first place in the undergraduate team division for their paper, "Stereoscopic Mixed Reality in Unmanned Aerial Vehicle Search and Rescue." Dr. Anil Deane is the faculty advisor.

BLAIRE WEINBERG, **JULIETTE ABBONIZIO**, and **JOSEPH BREEDEN**: third place in the undergraduate team division for their paper, "Engineering of a Tribocharging Regolith Simulant Experiment." Professor Christine Hartzell and Professor Mary Bowden are the faculty advisors.

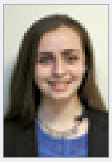
UMD had a strong showing at this year's AIAA Region 1 Student Conference.

AIAA sponsors student conferences in each AIAA Region for student members at both the undergraduate and graduate levels. The conference is open to anyone interested in aerospace related fields. Students from regional schools are invited to submit papers and give formal presentations that are judged for technical content and communication skills. Monetary prizes are awarded to the top three winners in each category.

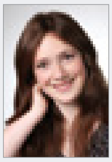
>> FOR MORE INFORMATION, VISIT https://go.umd.edu/region1

Five AE Students Named ARCS Scholars

The Achievement Rewards for College Scientists (ARCS) Foundation Metro Washington Chapter has selected five aerospace engineering students—four undergraduates (Madeline Caracappa, Elizabeth McFarland, Julia Mittelstaedt, and Haley Patel) and one graduate student (Elaine Petro)—as ARCS Scholars for 2018-2019. The ARCS Foundation advances science and technology in the United States by providing financial awards to academically outstanding students studying to complete graduate degrees in science, engineering and medical research.

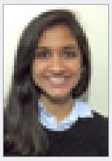


MADELINE CARACAPPA, a previous recipient of the award, has participated in a number of high-altitude payloads. Balloon launches typically cluster five or six payloads suspended below a high-altitude balloon. After launch, balloons can fly to altitudes ranging from 90,000 to 100,000 feet (near space). The balloon then bursts, and the payload cluster returns to earth suspended from a parachute. Her research has enabled her to gain hands-on engineering skills while developing sophisticated instruments to measure key characteristics of the atmosphere. Caracappa is also member of the Women in Aeronautics and Astronautics organization.

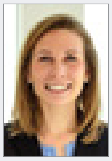


ELIZABETH MCFARLAND is part of Aerospace Honors, which has been very helpful to her academically and in exposing her to the industry. She has recently been interning and working at the Johns Hopkins University Applied Physics Laboratory on the development of a robotic hand lens for future planetary landed missions, which has been a valuable learning experience as she is very interested in the space track of aerospace.

JULIA MITTELSTAEDT is pursuing research in comparing electric and gas propulsion, pitting an electric motor against a fuel engine of equal mass, at the same speed, with identical propellers, to determine which system has a longer endurance. Part of UMD's Honors College, Mittelstaedt was recently elected as Communications Chair for Women in Aeronautics and Astronautics (WIAA). Mittelstaedt will be interning at Sikorsky Aircraft Corporation in Stratford, CT this summer working on the CH-53K helicopter.



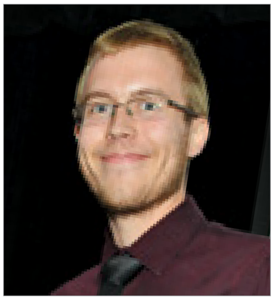
HALEY PATEL, a previous recipient of the award, has been studying how robots interact with humans by looking at how humans anthropomorphize robots and how the "gender" of the anthropomorphized robot can affect robot system/operator interactions. She has worked on developing a system to assess how a male or female operator reacts to a robot anthropomorphized with either a male or a female voice. Patel is also a member of the Women in Aeronautics and Astronautics organization.



ELAINE PETRO, a Ph.D. student in the Space and Propulsion Laboratory, is also previous recipient of the award. Her work involves the development of a water-propelled helicon thruster with specific impulse control. Her focus is looking at operating the helicon thruster—a type of ion propulsion system—with water vapor as a propellant to achieve performance suitable for deep space exploration missions. Through her research, she has helped developed a water vapor ionization model that predicts plasma characteristics such as the molecular composition and energies of ions created as a function of the electron energy. These plasma characteristics determine the achievable thrust and specific impulse. These and additional loss mechanisms in the helicon source have been incorporated into a power balance analysis in order to predict and optimize thruster efficiency.

FRIZZELL WINS NSF GRADUATE FELLOWSHIP

Eric Frizzell was awarded the National Science Foundation (NSF) Graduate Fellowship. Frizzell works in Dr. Sedwick's Space Power and Propulsion Lab and Center for Orbital Debris Education and Research. His research spans conjunction assessment, space traffic management, and parallel computing. He is passionate about keeping Low Earth Orbit open and usable. Eric is currently conducting research to determine how beacons placed on satellites can improve the estimate of an object's position through time and frequency differencing. His long-term goals include opening the solar system to human exploration and finding solutions in space to meet energy needs on Earth.



Students Receive Vertical Flight Foundation Scholarships

SIX STUDENTS FROM THE DEPARTMENT OF AEROSPACE ENGINEERING WON SCHOLARSHIPS FROM AHS INTERNATIONAL—THE VERTICAL FLIGHT SOCIETY.

Scholarship winners at the Vertical Flight Society's 74th Annual Forum & Technology Display.

In the bachelor degree category, Peter Ryseck won the Professor Donald M. Layton Scholarship, which honors the former US Naval Postgraduate School professor and system safety expert.

In the master degree category, Daniel Escobar, Bernadine Passe and Wanyi Ng received awards. Daniel Escobar won the Bob Lynn Memorial Scholarship, which honors the memory of the former Bell Helicopter executive and AHS leader for excellence. Bernadine Passe received the Eric Robeson Memorial Scholarship, honoring an outstanding engineer in the US Army's Aviation Integration Directorate. Wanyi Ng won the Hal Andrews Scholarship, which remembers a preeminent Navy aviation engineer, advisor and historian.

In the doctorate degree category, Seyhan Gul and Stacy Sidle were recognized with awards. Seyhan Gul won the Professor Marat Tishchenko Scholarship, honoring the former head of the Mil Moscow Helicopter Plant, and professor at Moscow Aviation Institute and University of Maryland. Stacy Sidle received the Dr. Alfred Gessow Scholarship, honoring a pioneer in the helicopter field at NACA/NASA and founder of the University of Maryland rotorcraft center.

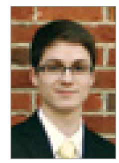
"We are delighted to recognize 25 of the top engineering students from around the world," said AHS International Executive Director Mike Hirschberg. "Since 1977, our Vertical Flight Foundation Scholarships have helped inspire generations of students to pursue careers in vertical flight, with many now holding leadership positions in industry, academia and government."

The VFF was established in 1967 as the philanthropic arm of AHS. Since 1977, the merit-based scholarship program has been a great success story: over 500 scholarships have been awarded since that time. The program has been greatly expanded in recent years, with the number of recipients nearly doubling in the last decade, and the total annual scholarship disbursement nearly tripling. Since 2012, more than 150 VFF scholarships totaling over $450,000 have been awarded—prior to this time, annual scholarships generally totaled about $33,000.

Founded in 1943 as the American Helicopter Society, Inc., AHS International, The Vertical Flight Society, is now the global resource for information on vertical flight technology. The society advocates, promotes and supports global vertical flight technology and professional development.

McCullum Receives SMART Scholarship, Whalen Wins NSTRF

Jacob McCullum, an Aerospace Engineering Honors student, was selected for the Department of Defense (DOD) Science,



Mathematics and Research for Transformation (SMART) scholarship. The DOD SMART scholarship is a service program that offers college students the opportunity to receive a full scholarship and be employed by DOD after completing their degrees.

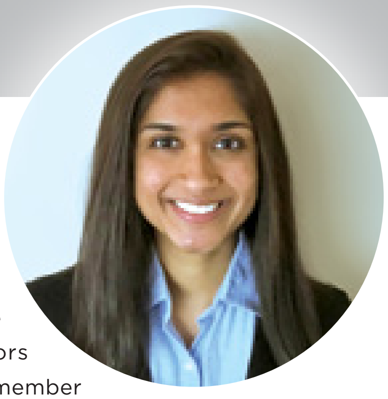
Advised by Minta Martin Professor of Aerospace Engineering and Chair Norman Wereley, McCullum is conducting structural health monitoring (SHM) research in the Composites Research Laboratory. His research involves the use of piezoelectric sensors/actuators and explores the application of the guided wave method of SHM applied to an F/A-18C wing section.

Thomas Whalen, a Ph.D. student and graduate research assistant in the High-

Speed Aerodynamics and Propulsion Laboratory, won a NASA Space Technology Research Fellowship (NSTRF) for research related to the characterization of separation events in high-speed flows.

Advised by Assistant Professor Stuart Laurence, Whalen's research is important for improving trajectory prediction capabilities of de-orbiting space debris and precluding re-contact of rocket boosters during payload ascent.

NASA Space Technology Fellows perform innovative, space technology research at their respective campuses and at NASA Centers and/or at nonprofit U.S. Research and Development laboratories. Awards are made in the form of training grants to accredited universities.



FEARLESS AMBITION IN AEROSPACE

GROWING UP, HALEY PATEL REALLY ENJOYED MATH AND PHYSICS. In high school, she decided that she wanted to pursue a field that encouraged innovation and focused on the development of new technology. Now, as a senior and an honors student in the Department of Aerospace Engineering, Patel can reflect back on her childhood ambitions and know she has achieved her goal.

Patel discovered aerospace engineering after her first semester and immediately knew it was the right fit. "Aerospace engineers are putting really incredible technology and people into the sky," she said. Patel credits UMD's First-Year Innovation and Research Experience (FIRE) program with introducing her to her passion. "In FIRE, I did things with swarm robotics that helped me get my first internship."

Once Patel declared the major, she never looked back. To date, she has completed an internship at the Nyheim Plasma Institute as well as an internship with NAVSEA through the Naval Research Enterprise Intern Program. Her list of accomplishments doesn't stop there. Patel is currently the Vice President of the senior Design, Build, Fly capstone team and the Public Affairs Officer of Sigma Gamma Tau, the aerospace engineering honors society. She is also an active member of UMD's Women in Aeronautics and Astronautics and AIAA student chapters.

"A lot of the opportunities happened because I was willing to put myself out there," says Patel, a two-time recipient of the ARCS Scholarship and a recent recipient of the Emergent Space Technologies Scholarship. "I had so many awesome people help me out my freshman year, and I just want to do the same for others."

As a peer mentor for the University Honors program and a peer advisor in the Engineering Career Center, she is doing just that. Under the direction of Dr. Stuart Laurence in the High-Speed Aerodynamics and Propulsion Lab, Patel is also busy working on her honors research thesis. "I'm really excited to apply what I've learned and start working in the industry next year," she says.

RECENT ACHIEVEMENTS

- ARCS SCHOLAR
- WYLIE DISSERTATION FELLOWSHIP
- PENTON AVIATION'S 20 TWENTIES
- BEST TEACHING ASSISTANT
- WIAA FOUNDING MEMBER

PHOTO: JENNIFER FIGGINS ROOKS

ONWARDS AND UPWARDS

ELAINE PETRO HAS ALWAYS BEEN INTERESTED IN THE PLANETS AND WHAT LIES OUTSIDE OUR SOLAR SYSTEM. Growing up, she enjoyed physics and math and watching rocket launches with her family. So it's not surprising that she majored in Aerospace Engineering as an undergraduate. After graduating from UMD with honors, she still had a desire to deepen her knowledge and experience.

"I wanted to learn how to think independently and to innovate," she says.

That desire spurred her decision to accept a position at NASA Goddard Space Flight Center, where she worked on various flight projects, including MAVEN, a Mars Orbiter and the James Webb Space Telescope. "I did a combination of analysis work—calculations predicting performance—and integration and testing work in the cleanrooms with the flight hardware," she recalls.

After three years at Goddard, she decided she wanted to pursue a research-oriented career that presented new challenges every day and encouraged her to develop innovative solutions. This led her back to UMD to pursue graduate studies in Aerospace Engineering.

"It's an exciting time to be part of the space industry with exploration and the commercial sector growing, and I thought the skills I learned in graduate school would position me well to contribute," says Petro, who won the 2018 Alex Brown Leadership Award, which includes a $1000 scholarship and a commemorative medal.

After she completes her Ph.D., Petro intends to pursue a post-doc at MIT in their Space Propulsion Laboratory and then join the faculty at Cornell University in the Sibley School of Mechanical and Aerospace Engineering in July 2020.

"My goal is to become a university professor because I believe it will allow me to pursue all of my passions: working on cutting edge space systems, recruiting young people—especially women—into STEM and aerospace engineering, and revamping our courses and degree programs so we best prepare students to be successful in their careers," she says.

A New Venture in Aircraft Design

AEROSPACE ALUMNUS SAYS HIS LEARNING EXPERIENCE AT UMD HAS HELPED HIM SUCCEED IN THE REAL-WORLD.

Alumnus Suneal Guptaa (B.S. '03; M.E. '05) recently founded the consulting company, Guptaa Unmanned Aero LLC, which specializes in unique aeronautical core competencies for all aspects of air vehicle design, analysis, and testing. Based in Baltimore, the company offers a full range of design services, including aircraft design, aerodynamic modeling, aircraft performance, Computational Fluid Dynamics, MATLAB-based simulation and data analysis, stability and control, and wind tunnel/flight-testing.

"Like any business, you're after answers," says Guptaa, who has fond memories of working under Dr. Palumbo (his first supervisor at AAI Corporation) who now teaches the Principles of Aircraft Design (ENAE 481) at the University of Maryland. "I've been fortunate over the last 14 years to design aircraft for AAI Corporation and learn a great deal along the way. My new company is driven by innovation that leverages a unique set of skills."

Guptaa, who holds two U.S. Patents in unmanned aerial vehicle (UAV) design, has worked on projects for the Army, Navy, and Marines and is now pursuing customers in the larger UAV industry.

"One of the coolest things I did was travel to Afghanistan during [Operation Enduring Freedom] to see one of the UAV's I helped design perform in-country during wartime operations," he recalls. "It was truly amazing to be part of the project and see that aircraft in action."

In addition to design, analysis, and testing projects, Guptaa's company also offers professional short courses on topics including Numerical Methods for Engineers (MATLAB) and UAV Flight Test (Air Vehicle Performance and Data Analysis). Some of the topics within the UAV design and analysis space include numerical integration, root finding, interpolation, and curve-fitting. UAV aeronautical testing requires rapid solution of classical equations in often under-constrained conditions.

"My courses leverage linearization, empirical assumptions, and rapid-analysis techniques to solve classical formulations quickly and accurately," Guptaa observes. "The courses are perfect for college graduates. We translate theoretical practices into usable methods for everyday engineering design and analysis."

Business so far has been good. The company recently landed a few commercial contracts and is engaged in designing some new airplanes.

"Virtually everything I did in the classroom at the University of Maryland, I did in my job after I graduated and continue to do now," says Guptaa. "I like the technical side of things, so I decided to launch this new venture and it is going very well. I look forward to continuing to grow business diversity with minority representation through cognizant, competent, aeronautical design and analysis."

Want to Share Your Story?

CONTACT
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Fearless Ideas: The Campaign for Maryland is a $1.5 billion fundraising effort to enhance the university's service mission, academic distinction, and research enterprise. In the Department of Aerospace Engineering, Fearless Ideas is a catalyst for expanding our life-changing opportunities for students. We empower our students with hands-on learning experiences, competitions, and research projects that change how they think about problems in the world. You can help by supporting **The John Anderson Scholarship**, **The Alex Brown Memorial Graduate Fund**, or **the Chair's Fund**. Learn more inside, and join us!

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