MARYLAND AEROSPACE ENGINEERING | **FALL 2023**

AEROCONTACT

Spotlight on space

From engineering extraterrestrial habitats to protecting the Earth from asteroid collisions, UMD space engineers set their sights on the final frontier.

DEAR FRIENDS,

Our species is fascinated by space for multiple reasons. We aspire to expand outwards, potentially building extraterrestrial habitats. We crave the insights that we can gain about the nature of the solar system, the galaxy, and the universe as a whole, including possible clues about the origins of life here on Earth.

UMD researchers are involved in all these aspects of human engagement with space. When we do begin building extraterrestrial bases, first on the Moon and perhaps later on Mars, these endeavors will likely leverage tools, technologies, and know-how obtained at our Space Systems Laboratory (SSL), profiled in this issue. Directed by Professor David Akin, the SSL has experimented with everything from habitat infrastructure to spacesuit design to the possible utilization of robot assistants. Much of the lab's pioneering research is made possible by a unique resource, the Neutral Buoyancy Research Facility, which allows researchers to simulate the unforgiving environment of space. The only such facility in the world to be located on a college campus, and the only one dedicated to basic research, it comes with a full panoply of equipment, from comms systems to simulated space vehicles, underwater cameras, and robotic manipulators, thus supporting ambitious space-related experimentation without the cost and hazard of sending teams out into space.

The SSL is an incredible asset for space engineers, but it's not our only one. Another is the Planetary Surfaces and Spacecraft Lab, headed by Associate Professor Christine Hartzell. The lab is involved in several key NASA and international missions aimed at furthering our understanding of how objects in our solar system formed; these include the OSIRIS-REx mission, centered on the asteroid Bennu, and the Martian Moons eXplorer Mission, led by the Japanese Aerospace Exploration Agency (JAXA) in partnership with France's National Center for Space Studies (CNES) and the German Aerospace Center (DLR). Researchers at the lab have also contributed to the DART mission, which tested the feasibility of deflecting space objects on a collision path with Earth.

Our space research capabilities at UMD are complemented by an abiding commitment to offering students opportunities to get involved; multiple undergraduate courses, ranging from freshman to senior level, center around SSL projects. Our student-centered approach is, however perhaps most strikingly evident in our Balloon Payload Program, also known as Maryland Nearspace. For more than 20 years now, the program has given aspiring space engineers the chance to acquire practical experience with the process used in NASA satellite launches; though the program's balloons may not reach the altitude of a spacecraft, its missions replicate the process used to design, build, and fly space-bound rockets.

You'll learn more about the many facets of space engineering at UMD in this issue of *AeroContact*. And we'll also update you on exciting developments in other areas, including the establishment of a new VR-based flight simulation lab. At UMD, we're always moving things forward, while keeping things student-centered. We wouldn't have it any other way.

Best regards,

Alison Flatau
PROFESSOR AND CHAIR
DEPARTMENT OF AEROSPACE ENGINEERING

SPECIAL SECTION

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AEROCONTACT

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Please send letters to the editor and alumni notes to aero-comms@umd.edu.

HOME, SWEET MOON BASE

DESTINATION: SPACE

UMD's Space Systems Laboratory, Neutral Buoyancy Research Facility, Planetary Surfaces and Spacecraft Lab, and Balloon Payload Program provide a wealth of educational and training opportunities for students, while supporting research that helps build our future in space—literally.

A new era of space exploration is under way, and researchers at the University of Maryland's (UMD) Space Systems Laboratory are tackling the logistics of extraterrestrial living.

With both the United States and China having declared the intention to build moon bases within the next decade, space engineers are increasingly focused on devising feasible plans for building habitats on the Moon or Mars. Space travel is complicated enough on its own, and settling down for an extended stay presents another formidable set of engineering challenges.

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(CONT. FROM PAGE 1)

Buildings, infrastructure, and furnishings would all have to be designed for lower-gravity conditions—one-sixth the Earth's gravity in the case of the moon, and about 38% on Mars. Engineering for such conditions is complicated by the cost and complexity of space travel: most testing can't be feasibly carried out at the destination site. Rather, the extraterrestrial environment must be replicated here on Earth.

That's where facilities such as UMD's Space Systems Laboratory, under the direction of aerospace engineering professor David Akin, play an essential. Climb the stairs to the SSL's headquarters on the UMD campus and you'll see what looks at first glance like a large swimming pool. In fact, this 50-foot-wide, 25-foot-deep tank, holding approximately 367,000 gallons of water, can be used to simulate conditions of reduced gravity or even no gravity at all. Equipped with a 16-camera movement tracking system and dexterous manipulators designed and built in-house specifically for autonomous or remotely controlled underwater operations, the facility supports experiments involving human SCUBA divers as well as any of its 16 in-house robots and autonomous vehicles.

It's the only such facility in the nation to be housed on a college campus. Just as importantly, it's just down the road from NASA's Goddard Space Flight Center, making it an obvious go-to resource for NASA scientists and engineers involved in space exploration missions such as the Artemis program, which aims to set up a lunar base by 2028.

Akin and his team of undergraduate and graduate students have set out to tackle the entire range of space habitation problems, starting with tasks as simple as climbing a set of stairs. "Let's say I have a two-story habitat on the moon," Akin explains. "If I start up a staircase on the moon the way I would on Earth, after my first step I'm going to float up about six feet. At lunar gravity, there's so much more power in my legs than I need, in that gravity field, so maybe I can have the steps farther apart."

To identify an optimal configuration for lunar stairs, the SSL team built

FOR ASTRONAUTS, A ROVING ROBOT CAN LIGHTEN THE LOAD

Astronauts don't exactly travel light. The Portable Life Support Systems (PLSS) carried by the Apollo astronauts weighed hundreds of pounds, and although the weaker gravity on the Moon reduced that weight by about four-fifths, they still were a heavy lift. NASA's current Artemis mission budgets for even heavier backpacks and garments.

But what if needed life support equipment could be transported by a robot rather than lugged around on an astronaut's back? That's the idea behind BioBot, a rover now under development at the SSL."It's an intelligent rover that follows you around and carries your backpack for you," explains SSL Director David Akin. "You need an umbilical for the air and water to come in through your suit, and you don't want this umbilical dragging along the ground. So the BioBot has an arm with a 15-foot reach that holds the umbilical above the ground."

Freed from the burden of lugging their PLSS systems around, and with a friendly robotic rover nearby to help, astronauts can devote more of their time and energy to exploring and studying their surroundings. BioBot, which Akin describes as "more advanced than anything NASA has seen yet," has been designed and built at the SSL and will soon be sent out—along with human companions—to a site such as a quarry, for tests by Akin's team and their partners at NASA Innovative Advanced Concepts, which is funding the project.

The extraterrestrial environment must be replicated here on Earth.

prototypes, submerged them in the NBRF tank, and then had test subjects climb them, carrying cargo supply bags that had been weighted in order to simulate the task of carrying equipment. “We experimented with different distances between steps and different angles,” Akin said. “We wanted the user to be able to climb steps without using their hands, because they might need to carry things up and down. On the other hand, there isn’t a lot of space available on a moonbase, and a conventional staircase takes up too much room.” The best solution, as it turned out, resembled a ship’s ladder—steep enough to economize on space, but usable without hands.

Given the cost and logistical difficulties involved in constructing a habitat and shipping it to the moon, it’s no surprise that NASA is interested in finding economical solutions—for example, a foldable structure that can be packed up tightly, then inflated once the designation is reached. Akin and the SSL team not only designed and tested inflatable structures of this kind, but experimented with ways of outfitting them with foldable equipment and furnishings—all in the simulated lunar gravity provided by the NBRF tank.

Solutions like these may indeed find their way onto actual Moon or Mars bases in the not-too-distant future. Meanwhile, such projects also provide unique opportunities for UMD students to gain hands-on experience. Notes Akin: “We try to take research projects and find ways to leverage them to give students more opportunities in the engineering development process”

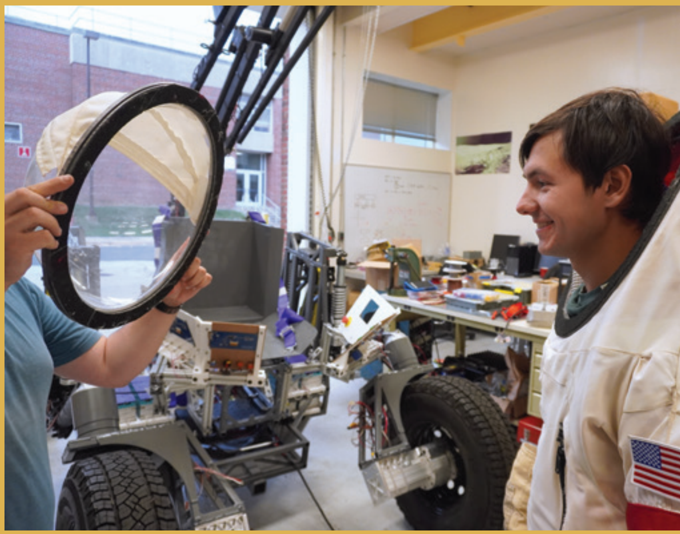
Indeed, students in a freshman-level course have helped design and construct astronaut seats and space-suits, while seniors in a capstone class recently came away with a NASA RASC-AL competition award for a proposal to build a lunar tourist center to support future recreational space travel.

Ingenuity like this is what can happen when you house a major space engineering research facility such as the NBRF on a college campus. The ideas flow. The solutions come. And a new chapter in space exploration takes shape.

FROM SEWING SUITS TO METAL FABRICATION, A ONE-STOP SHOP

A decades-old sewing machine might be the last thing you’d expect to see in a 21st-century space research facility. But the Singer machine at the SSL has special significance: it was used in sewing spacesuits for the Apollo astronauts who landed on the Moon in 1969. For SSL Director David Akin it serves as an inspiring reminder of that earlier, heroic era of space exploration, as well as an important piece of lab equipment.

Sewing, in fact, is among the tasks carried out regularly by Akin and his team of graduate and undergraduate researchers, though they use modern, industrial-grade equipment rather than the antique Singer. One of the things SSL does, after all, is help engineer spacesuits, and while part of the job involves making calculations and running simulations, the lab also fabricates prototypes. In fact, the SSL also houses a machine shop and multiple 3D printers, equipping it for practically any space engineering endeavor assigned to it by NASA, other federal agencies, or private companies. Most work is done by students, thus providing them with paid employment—and the chance to acquire hands-on experience with the design, fabrication, and testing of aerospace hardware.



Hartzell Selected for MMX Science Team

CHRISTINE HARTZELL, ASSOCIATE PROFESSOR OF AEROSPACE ENGINEERING AT UMD AND DIRECTOR OF THE PLANETARY SURFACES AND SPACECRAFT LAB, HAS BEEN SELECTED TO JOIN THE SCIENCE WORKING TEAM FOR THE MARTIAN MOONS EXPLORER MISSION, WHICH IS SENDING A SPACECRAFT TO PHOBOS—ONE OF TWO MOONS THAT ORBIT MARS—WITH A LAUNCH PLANNED IN 2024.

IMAGE: JAXA

Hartzell is among ten U.S. scientists tapped by NASA for the mission, led by the Japanese Aerospace Exploration Agency (JAXA) in partnership with France's National Center for Space Studies (CNES) and the German Aerospace Center (DLR).

The MMX spacecraft will land on Phobos twice to collect samples. It will also deploy a rover engineered by CNES and DLR—the first such vehicle ever to travel on the surface of a Martian moon, and in an environment of such low gravity. Rover deployment on Phobos is expected in 2027, with the craft then spending 100 days exploring the moon.

The findings, scientists hope, will reveal specifics that can't be gleaned from remote data, thus providing insights that could help explain Phobos's origins.

"We know the surface of Phobos is coated with loose rock and dust we call regolith," Hartzell said. "But does it behave more like dry sand, or more like baking flour, which is very clumpy? Clumps are formed due to strong cohesive bonds between the dust particles and we see them all the time on Earth, but we have never specifically looked for them on another planetary body. The presence or absence of clumps will be an indication of the material properties of regolith, which will inform our understanding of the surface of small moons and asteroids, and potentially inform the design of the next spacecraft to explore these bodies."

As an MMX participating scientist, Hartzell will use her analytical expertise, as well as modeling tools developed at her lab, to arrive at findings based on data sent back by the rover.

"The rover is equipped with cameras that look at the wheels as well as its navigational cameras, so we'll be able to watch as the wheel drives over a rock and see if the rock is coherent or if it crumbles," she said. A rock that crumbles is likely just a clump of smaller particles, like you see in baking flour.

> ***"Right now, we look at remote images of what seem to be rocks on asteroids or comets, but we're not really sure what they are."***

The findings can then be compared to analytical models, which predict that clumps should be present and also estimate the size of those clumps.

Scientists may also be able to extrapolate the findings to other bodies in the solar system in ways that have implications for space exploration and travel, Hartzell said.

"If we observe clumps on Phobos in this mission, it would be an indication that such clumps also occur on other bodies in the solar system," she said. "Right now, we look at remote images of what seem to be rocks on asteroids or comets, but we're not really sure what they are. If it turns out they are just clumps that crumble and fall apart, this could lead us to rethink how we design the wheels, other equipment, and operational procedures for other missions to other bodies."

A member of the UMD aerospace engineering faculty since 2014, Hartzell is also a scientist on the NASA SIMPLEx Janus Mission, which will send a pair of space vehicles to investigate two pairs of binary asteroids, as well as the OSIRIS-REx mission, which focuses on the study of near-earth asteroids. The OSIRIS-REx spacecraft arrived at its first destination, Bennu, in 2018, collecting samples and imagery that have transformed scientific understanding of the asteroid.

THEO & MUFN TEAM MEMBERS RAYMOND SQUIRINI, GRACE ZIMMERMAN AND MELISSA BUYS WITH PROFESSOR BRENT BARBEE AT THE 2023 PLANETARY DEFENSE CONFERENCE.

Planning for Planetary Defense

ASTEROIDS SMASHING INTO EARTH AREN'T JUST A HOLLYWOOD PLOT DEVICE: THOUGH THE PROBABILITY MAY BE LOW, IT'S NOT ZERO. TO HELP PLAN FOR A POTENTIAL THREAT, NASA'S CENTER FOR NEAR EARTH OBJECT STUDIES CREATES HYPOTHETICAL ASTEROID IMPACT SCENARIOS THAT CHALLENGE RESEARCHERS AND SCIENTISTS TO DEVISE SOLUTIONS.

This year, those ideas were presented during the International Academy of Astronautics' (IAA) annual Planetary Defense Conference (PDC) held in Vienna, Austria in April. UMD Department of Aerospace Engineering graduate students from the department's Near-Earth Object Exploration course came to the event equipped with a plan.

"As part of the class, we had a big group project to design a mission to a near-Earth asteroid," explained project team member Melissa Buys, a Ph.D. graduate student. "Professor [Brent] Barbee told us about the conference and the annual asteroid impact scenario and suggested anyone interested could use it for our mission design."

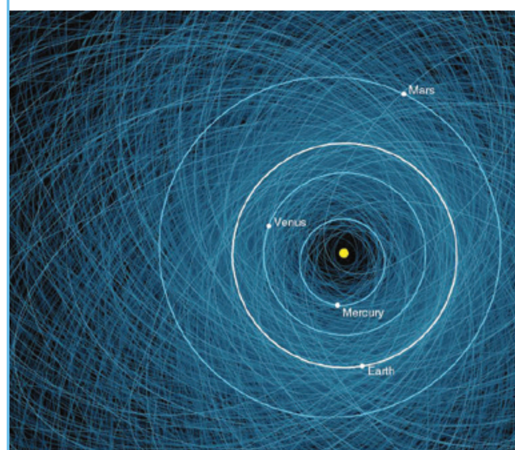
"The scenario's [hypothetical] asteroid, called '2023 PDC,' was 800m in diameter—a pretty substantial size for an asteroid," she said. "We think that it is very likely they chose such a big asteroid for the hypothetical scenario so we could have a conversation around using nuclear detonations in space, which are currently banned under international agreements."

The team's answer to a threat of such proportions was their Terrestrial Hazard Exploration Orbiter (THEO) and Mitigation Using a Fission Nuclear Device (MUFN), which provides a start-to-finish response that includes a rendezvous and observation mission to the asteroid, allowing for mapping and tracking, as well as a secondary mission in which a craft detonates a nuclear explosive device (NED) near the asteroid to ablate the surface, producing a momentum change strong enough to deflect it from its original Earth-impacting trajectory.

Once accepted by the IAA conference, several team members had the opportunity to travel to Vienna and present their work during the Planetary Defense Conference along with peers, researchers, and scientists from around the world.

"It was a surreal experience to be sitting in a room where people make decisions on the world about how things work, and we're talking about planetary defense," said Buys. The team's THEO and MUFN asteroid mission project also went on to take third place in the conference's student paper competition.

"I couldn't be more proud of or impressed by what the students have accomplished, both in their work in my course and how they performed at the conference," said Barbee, the team's mentor. "This is a great example of Maryland students doing world-class work, leading the way, and building a better future."



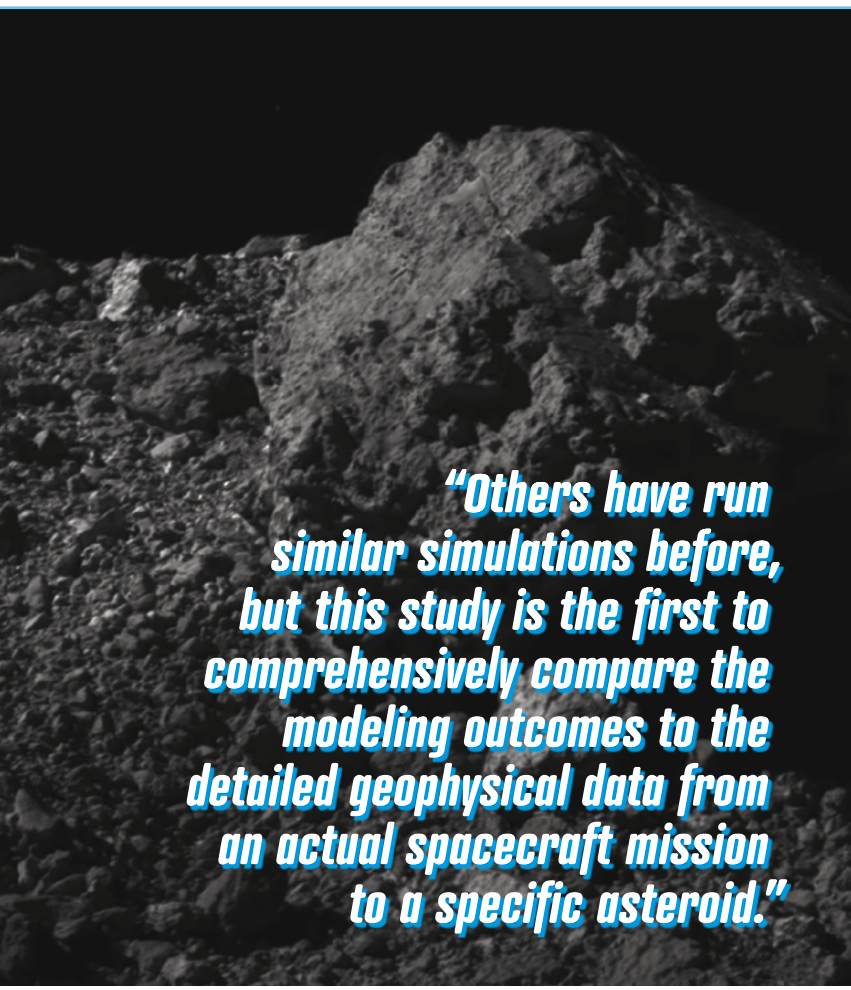
UMD Planetary Defense Conference THEO & MUFN Mission Team:

- **Melissa Buys**
  THEO SPACECRAFT DESIGN AND SCIENCE JUSTIFICATION
- **Raymond Squirini and Jonathan Gabriel**
  MUFN NUCLEAR PAYLOAD DESIGN AND CONOPS
- **Hannany Salehuddin**
  THEO SPACECRAFT DESIGN
- **Connor Wilson**
  MUFN SPACECRAFT DESIGN
- **Grace Zimmerman**
  TRAJECTORY DESIGN FOR THEO AND MUFN

NASA/JPL-CALTECH

Unlocking the Secrets of Bennu

INFORMATION ABOUT AN ASTEROID'S INTERNAL STRUCTURE PROVIDES CRITICAL CLUES ABOUT ITS ORIGIN AND EVOLUTION. BUT SINCE NO INTERNAL PROBES HAVE BEEN CONDUCTED ON THESE ROCK-LIKE CELESTIAL OBJECTS, SUCH INFORMATION CAN ONLY BE OBTAINED INDIRECTLY.



> ***"Others have run similar simulations before, but this study is the first to comprehensively compare the modeling outcomes to the detailed geophysical data from an actual spacecraft mission to a specific asteroid."***

New research led by UMD aerospace engineering post-doc Yun Zhang, currently a researcher in associate professor Christine Hartzell's Planetary Surfaces and Spacecraft Lab, could help scientists understand more clearly what asteroids are like on the inside—in particular, small to medium-sized asteroids that are known as "rubble piles" due to their loose, low-density composition.

Using the advanced computing capabilities available at UMD's Deepthought2 cluster, Zhang has in effect reverse-engineered the asteroid Bennu, by running simulations based on numerical models and determining which one best matches Bennu's observable features. Her findings were published on August 6 by Nature Communications, which featured it on its Editors' Highlights page.

"Using the numerical models, we can explore different types of internal structure and how they evolved over time, and then we can make comparisons to the external geophysical features measured by the OSIRIS- REx mission," Zhang said. OSIRIS-REx, launched by NASA in 2016, touched down on Bennu four years later, collecting a sample and conducting an extensive analysis of the asteroid's surface.

Zhang's findings suggest that Bennu came about as a result of a cataclysmic event—most likely a collision—that destroyed a previously existing, larger planetary body. The giveaway, Zhang said, is the diffuseness of its structure.

YUN ZHANG

"Asteroids of Bennu's size—namely, with a radius of about 200 meters—can be monolithic rocks rather than rubble piles," she said. "Even in the case of some rubble-pile asteroids, the interior can be comparatively monolithic. Our findings show that Bennu definitively falls into the rubble-pile category—its interior is very loose in its composition. Essentially, it's a hodgepodge of rocky chunks and fragments that have become held together by gravitational forces."

"The parent body, when it broke apart, produced thousands of fragments that eventually led to the formation not only of Bennu, but also many other rubble-pile objects, possibly including the nearby asteroid Ryugu," she said.

Both Bennu and Ryugu have been explored by space missions: Ryugu by the Japanese space agency's Hayabusa2 satellite, and Bennu by NASA's OSIRIS-REx, which has since sent a return capsule to earth, containing samples from the asteroid. While surveying Bennu, OSIRIS-REx made several observations that would provide crucial to Zhang's work; it confirmed, for instance, that Bennu does not have a moon. If it did, that fact would have necessitated a more cohesive interior.

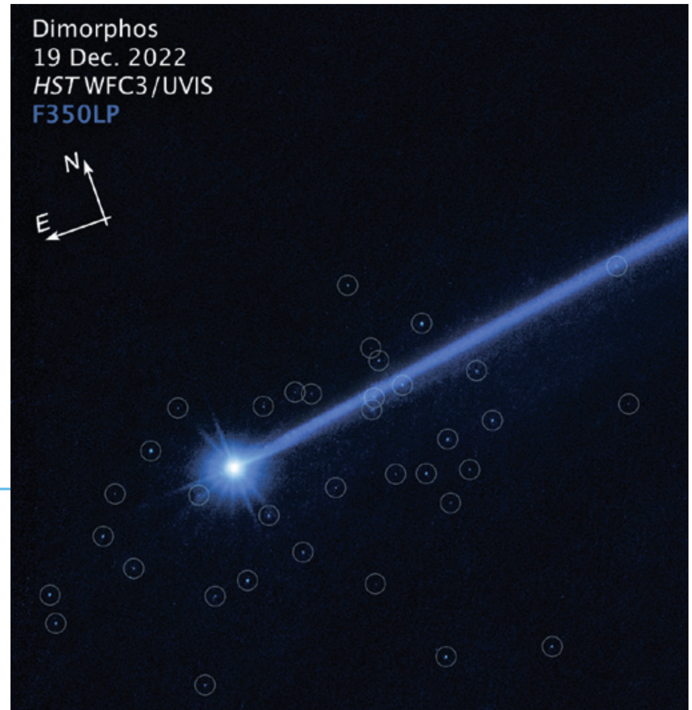
Zhang's models also factored in gravitational measurements obtained by the NASA spacecraft, as well as observations of surface slopes along with evidence of avalanches on Bennu's surface.

Her use of simulations in combination with OSIRIS-REx data makes her work pioneering, said Hartzell, the Planetary Surfaces and Spacecraft Lab director and a co-author of the *Nature Communications* paper. "Others have run similar simulations before, but this study is the first to comprehensively compare the modeling outcomes to the detailed geophysical data from an actual spacecraft mission to a specific asteroid."

The new research yields an additional take-home: even minor variations in an asteroid's internal composition can have far-reaching effects.

"In running the models, I found the range of outcomes to be quite striking," Zhang said. "A change in cohesion of even a few Pascals can affect an asteroid's structural evolution."

"This leads to very diverse evolutionary histories, and it explains why we can see so many different asteroid structures and shapes today."



THIS HUBBLE SPACE TELESCOPE IMAGE OF THE ASTEROID DIMORPHOS WAS TAKEN ON DECEMBER 19, 2022, NEARLY FOUR MONTHS AFTER THE ASTEROID WAS IMPACTED BY NASA'S DART MISSION (DOUBLE ASTEROID REDIRECTION TEST). HUBBLE'S SENSITIVITY REVEALS A FEW DOZEN BOULDERS KNOCKED OFF THE ASTEROID BY THE FORCE OF THE COLLISION. THESE ARE AMONG THE FAINTEST OBJECTS HUBBLE HAS EVER PHOTOGRAPHED INSIDE THE SOLAR SYSTEM. THE FREE-FLUNG BOULDERS RANGE IN SIZE FROM THREE FEET TO 22 FEET ACROSS, BASED ON HUBBLE PHOTOMETRY. THEY ARE DRIFTING AWAY FROM THE ASTEROID AT A LITTLE MORE THAN A HALF-MILE PER HOUR. THE DISCOVERY YIELDS INVALUABLE INSIGHTS INTO THE BEHAVIOR OF A SMALL ASTEROID WHEN IT IS HIT BY A PROJECTILE FOR THE PURPOSE OF ALTERING ITS TRAJECTORY.

CREDIT: NASA, ESA, DAVID JEWITT (UCLA), AND ALYSSA PAGAN (STSCI)

UMD RESEARCHERS HELP MEASURE DART'S SUCCESS

When she's not retracing the evolution of the asteroid Bennu, UMD's Yun Zhang is helping to assess the feasibility of a novel plan for planetary defense.

In September 2022, NASA intentionally crashed a probe into the surface of a moon orbiting the asteroid Didymos in order to help ascertain whether similar procedures could be used to deflect space objects on a collision course with Earth. Scientists, including Zhang and colleagues at the UMD astronomy department, have since been parsing data gleaned from the mission, with findings published in a series of papers appearing in *Nature*.

A key takeaway is that the idea worked. As Johns Hopkins Applied Physics Laboratory (APL) planetary scientist R. Terik Daly and his co-authors demonstrate in their paper, the moon Dimorphos's orbit changed as a result of being struck by the DART probe. Another paper, with APL scientist Andrew F. Cheng as the lead author, details the momentum transfer that occurred as the probe smashed into the moon's surface.

"Analysis of the DART data "demonstrates that kinetic impact is a viable technique to deflect an asteroid," said Zhang, who contributed to two of the papers. "DART impacted Dimorphos at a site within 25m of its geometric center. The momentum transferred to Dimorphos from DART is estimated to be more than twice DART's momentum, due to the recoil force from impact ejecta. This suggests that the DART kinetic impact was highly effective in modifying Dimorphos's orbit around Didymos."

Zhang's specific role was to interpret the density of the target based on her previous work on asteroids, thus enabling the team to obtain a more accurate estimate of the momentum transfer from the probe as it impacted the moon. Drawing from her Bennu research, she also provided insights concerning the moon's geophysical features. "Observations during and following the DART impact provide important information on the geological features of this binary system and the dust dynamical evolution in such an environment. In my further studies, I want to understand how this binary system formed in the first place," she said.

Besides demonstrating the feasibility of knocking space objects off a collision course with Earth, DART was important in another way: the information gained from the mission can be used to calibrate and validate numerical models and simulations that scientists in the future can use before a deflection mission is launched.

"With an improved understanding of an asteroid's structural response to impact, before undertaking any physical maneuver to deflect an asteroid, the scientists can run simulations first to predict the outcome and assess the deflection efficiency," she explained.

The need for effective methods of asteroid avoidance has been an ongoing topic of concern for the space community, and increasingly for lawmakers as well. In 2005, the U.S. Congress passed legislation directing NASA to carry out a comprehensive survey of near-earth space objects and devise methods for deflecting them.


IMAGE: NASA

Eclipse Ballooning:

MARYLAND NEARSPACE TAKES ON THE CHALLENGE

UMD'S BALLOON PAYLOAD PROGRAM LEADS A GROUP OF REGIONAL TEAMS IN NASA'S NATIONAL ECLIPSE BALLOONING PROGRAM.

Launching a high-altitude balloon is no easy task. Predictions of the flight path must be made in advance, taking into account wind direction and speed. A suitable launch site must be chosen. The weight of the payload must be measured and the necessary amount of lift calculated, along with flight duration, ascent rate, and target altitude. The balloon must be inflated with the correct amount of gas in order to achieve the desired lift.

Imagine doing all this for a launch that has to take place during a specific time window lasting only a few minutes, with practically no room for error. That's the challenge being taken on by the University of Maryland's Balloon Payload Program team, together with other teams involved in NASA's National Eclipse Ballooning Project (NEBP). The UMD team, known as Maryland Nearspace, is leading a regional "pod"—or group of teams—that includes schools from Alabama, Florida, Georgia, Pennsylvania and Virginia.

The mission: successfully launch high-altitude balloons to gather data during a pair of eclipses: an annular eclipse that occurred in October, followed by a total solar eclipse in April 2024. Approximately 70 teams in all, totalling more than 1,000 students, have been making the attempt.


THE UNIVERSITY OF MARYLAND'S (UMD) BALLOON PAYLOAD PROGRAM, KNOWN AS MARYLAND NEARSPACE, HAS CONDUCTED MORE THAN 100 HIGH-ALTITUDE BALLOON LAUNCHES SINCE ITS INCEPTION IN 2003.

As Maryland Nearspace Director Mary Bowden explains, "you can only do so much with data from a single flight. What we're going to get is a distributed set of data from along the entire path of totality." Atmospheric scientists will then be able—among other applications—to use this information to calibrate weather models, leading to improved predictions.

Considering that solar eclipses aren't a frequent occurrence, it's an opportunity not to be missed. In fact, notes Bowden, another total solar eclipse won't be visible from the contiguous United States until August 2044.

The educational value of the experience is as important as its scientific aspect, said Bowden, noting that the student teams will be gaining hands-on experience with a process that resembles that used in rocket launches. Maryland Nearspace has perfected this process—known as Design, Build, Fly—during more than 100 balloon flights since its establishment in 2003. The eclipses, with their tight time window and deadlines imposed by the cosmos, present a uniquely challenging test of this approach.

"Many of our students want to be space engineers, and so we're giving them an opportunity to go through an experience that's very similar to building payloads and launching them on rockets. It's motivational, it's educational, it's just and it's fun."

Support UMD students participating in this once-in-two-decades scientific and educational opportunity!

DONATE TODAY AT **go.umd.edu/supportBPP**

UMD Aerospace Gets VR Flight Simulators

Umberto Saetti, assistant professor and director, Extended Reality Flight Simulation and Control Lab.

AUGMENTED REALITY, HAPTICS COMBINE TO CREATE IMMERSIVE AVIATION EXPERIENCES.

New motion-base Virtual Reality (VR) simulators installed at UMD aerospace engineering faculty member Umberto Saetti's Extended Reality Flight Simulation and Control Lab will enable researchers and students to develop and test advanced flight control systems and innovative cueing methods, and to study human-machine interaction.

Used in combination with full-body haptic feedback suits, the simulators support fully immersive, Extended Reality (XR) experiences that replicate piloting a variety of aircraft, including fixed wing airplanes as well as rotorcraft.

"We're harnessing extended reality in ways that push the research envelope and support exciting new applications," said Saetti, who joined the UMD aerospace engineering (AE) faculty in 2022 as an assistant professor.

The NOVASIM VR Simulator is designed by BRUNNER, a leading company in virtual-reality flight simulation hardware, and provides "a fully equipped motion platform, connected with all necessary units, including Joystick, rudder pedals and yokes in a more lightweight, flexible way compared to other FFS," the company said.

It represents a step forward from the bulky systems—often costing millions of dollars per unit—that were used in the past for similar types of research, said Saetti, who teaches and conducts research as part of the AE department's renowned Alfred Gessow Rotorcraft Center (AGRC).

"We used to rely on large projected screens that were mounted on large motion base systems, and you would need a different cockpit model for each type of aircraft that you wanted to simulate," he said. "In our system, by contrast, we can just swap out one virtual cockpit for another, and plug in any flight dynamics that we are interested in."

Haptic TESLASUIts, meanwhile, allow users to experiment with using tactile stimuli to obtain information on aircraft motion, desired landing zone locations and rotorcraft noise via tactile rather than visual or auditory cues. "Through electro-muscular stimulation, the pilot can receive this information through an alternate sensory channel," Saetti said.

In military contexts, haptics could be used to alert pilots that an aircraft is being followed, indicating the other aircraft's relative position, velocity, and acceleration. Saetti also plans to utilize the system to build on his previously published research on flight control systems in helicopters when landing on ships.

Aerospace engineering graduate student Michael Morcos tries out one of the BRUNNER motion-base VR simulators installed at University of Maryland (UMD) assistant professor Umberto Saetti's Extended Reality Flight Simulation and Control Lab. UMD is one of the only universities in the U.S. to house motion-base VR simulation equipment, which can reproduce flying conditions in a wide variety of aircraft.

The technology also opens up the possibility that users who do not meet the visual requirements to pilot aircraft could someday do so. Indeed, with haptics, an aircraft could even be flown by a visually impaired or blind pilot.

The idea has precedents. In 1946, Helen Keller took the controls of a four-engine Douglas C-5 Skymaster and flew it for 20 minutes, en route from Rome to Paris. In 2002, deaf-blind teenager Katie Inman successfully demonstrated the use of tactical signing in flight instruction, flying the plane with one hand while communicating with her instructor through signs drawn in her other palm.

In a virtual flying environment equipped with haptics, a pilot like Keller or Inman could learn to fly an aircraft without needing to see or hear. "Say a helicopter rolls to the right," Saetti said. "The pilot would recognize this through the feel on his or her body, and also be able to take the correct steps to recover, by detecting the changes in haptic stimulation."

Alison Flatau, chair of the UMD aerospace engineering department, said she is excited to see Saetti and other faculty investigating novel areas of research with the help of advanced technologies. "Aerospace engineering is an increasingly interdisciplinary fast-moving field, and we aim to be on the leading edge of research that embraces creative insights and opportunities to advance our field," Flatau said. "The new systems being made available at Dr. Saetti's lab provide capabilities that are available at few other universities."

ArtIAMAS receives third-year funding of up to $15.1M

The University of Maryland's (UMD) five-year ArtIAMAS (AI and Autonomy for Multi-Agent Systems) cooperative agreement with the U.S. Army Research Laboratory (ARL) has received third-year funding of up to $15.1 million. Willis H. Young, Jr. Professor Derek Paley, the director of the Maryland Robotics Center, is the lead researcher for this wide-ranging project, which spans engineering, robotics, computer science, operations research, modeling and simulation, and cybersecurity. The agreement builds on a more than 25-year research partnership between UMD and ARL in AI, autonomy, and modeling and simulation. The overarching goal is to develop safe, effective, and resilient capabilities and technologies that work intelligently and cooperatively with each other and humans.

The third-year funding is one of the largest single-year sponsored research awards ever to have been received by UMD's A. James Clark School of Engineering. It brings the ArtIAMAS funding total to $26.8M to date. ArtIAMAS began in May 2021 and funding may reach $68 million.

"This large project supports more than 50 faculty and more than 120 students,' Paley said. "Notably, there are eight subcontracts planned for Year 3, including three HCBUs."

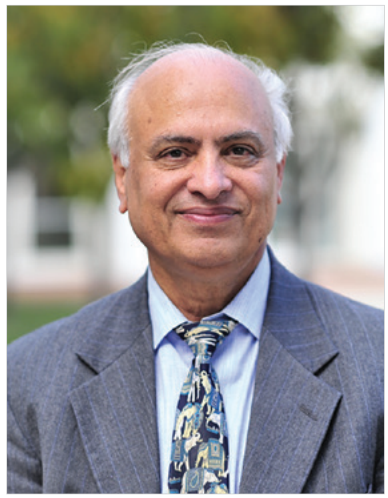
ArtIAMAS university subcontracts exist for the University of Maryland Baltimore County, Bowie State University, and University of Nebraska-Lincoln; university subcontracts to be added in Year 3 include George Mason University, Howard University, and Morgan State University. Two new industry subcontracts, Booz Allen Hamilton and Stormfish Scientific Corporation, are joining the endeavor as well.

Co-PIs are Catholic University professor Jeffrey W. Herrmann and UMD Distinguished University Professor Dinesh Majnocha (CS/UMIACS/ECE).

AIAA Honors Chopra With Crichlow Prize

To say that UMD Distinguished University Professor Inderjit Chopra has had a transformative impact on rotorcraft engineering would be something of an understatement. Through his research and experimentation, and just as importantly through his decades of teaching and mentorship, his influence has been seminal.

In recognition of his outsized contribution, the American Institute of Aeronautics and Astronautics honored Chopra this year with the 2023 Walter J. and Angeline H. Crichlow Trust Prize, one of the most prestigious awards in the field. The award was presented to Chopra at the 2023 AIAA SciTech Forum in January.



Inderjit Chopra

Alison B. Flatau, chair of aerospace engineering at UMD, welcomed news of the recognition. "Inder is a valued colleague and has had a full and distinguished career," she said. "He has had a tremendous impact on both the department and the Alfred Gessow Rotorcraft Center (AGRC), and is highly deserving of this recognition for his contributions to our profession and our students."

The AGRC is one of only three rotorcraft Centers of Excellence in the nation, the others being at Georgia Tech and Penn State. As its director, Chopra supervises the training and education of approximately 50 graduate students, as well as 30-40 undergraduates each year.

His direct graduate advising resulted in 61 Ph.D. and 125 M.S. degrees, with many of his students having gone on to key positions in the rotorcraft industry, academia, and federal labs.

"Dr. Chopra has mentored many generations of scholars as well as faculty worldwide, and together with Dr. Gessow built the rotorcraft Center as it stands today," said fellow UMD faculty member Anubhav Datta, who earned his doctoral degree at Maryland, studying under Chopra. "His students have built their own centers and major rotorcraft programs in at least five other US universities—some of whom are our major competitors today—and many others internationally."

Among them is Edward Smith, director of the Vertical Lift Research Center of Excellence at Penn State, who earned his doctorate at UMD in 1992. "By any measure, Professor Chopra stands out in every category of what a faculty member is expected and encouraged to do—research, teaching, and service," Smith said. "You cannot attend a single meeting or conference without encountering numerous students who benefitted from Prof. Chopra's positive impact in each of these key areas. He is beloved and respected by generations of Rotorcraft Center graduate students at the University of Maryland."

Chopra "set high standards for us, helped us in so many ways, during our education and throughout our careers, and always led by example," he said. "We are thrilled that AIAA has honored Prof. Chopra's contributions with the prestigious Chrichlow Award."

"I believe that Dr. Chopra's legacy is the many students that he has mentored over the years that have gone on to very highly successful careers in academia, government and industry," said James Baeder, Samuel P. Langley Professor of Aerospace Engineering

UMD President Darryll J. Pines (left), then Dean of the A. James Clark School of Engineering, and Alfred Gessow Professor of Aerospace Engineering Inderjit Chopra (third from left) talk with students involved in the Gamera human-powered helicopter project. The UMD-designed helicopter broke world records for flight duration and flight duration by a female pilot.

at UMD. "As such his former students are very loyal to Inder; many of them have then sent their own children to attend Maryland."

Over the years, Chopra and his students have racked up history-making achievements, notably the Gamera human-powered helicopter, which broke world records in 2013. More recently, he supervised a student team that succeeded—centuries after the idea was first proposed—in creating an aerial screw based on the designs of Leonardo da Vinci.

Lauded as he has been for his mentorship, Chopra is also known in the field as an exemplary researcher, scholar, writer, and editor, with 250 journal papers and 440 conference papers to his credit, as well as two influential books—one on smart structures, and the other on human-powered rotorcraft flight. He has served as associate editor of several leading journals in the field, including his current associate editorship of the AIAA Journal of Aircraft. Over the course of a career now spanning half a century, he has applied himself to fundamental problems related to aeromechanics of helicopters including advanced designs, aeroelastic stability, active vibration control, composite blades, smart structures, micro air vehicles and delivery drones, and comprehensive analysis.

He has also contributed greatly to the international reputation of UMD's A. James Clark School of Engineering and its aerospace engineering department in particular, his colleagues noted.

"The high regard with which our aerospace department is viewed world-wide is in large part due to him and his center," Datta said. Baeder concurs, noting that Chopra has been a "tireless promoter of the Clark School of Engineering, the aerospace department and the Alfred Gessow Rotorcraft Center."

UMD President Darryll Pines, who began his UMD career as an aerospace engineering professor, teaching and conducting research together with Chopra, noted the breadth and depth of his colleague's legacy. "He has made significant contributions toward future designs and systems. His graduates are everywhere throughout industry, government, and academia," Pines said. "He has a lifelong legacy of impact on the field that will last for generations to come!"

Noted Datta: "This year AIAA has recognized two of the living legends of rotorcraft—Dr. Wayne Johnson of NASA Ames, with the Guggenheim Medal, and now Dr. Inder Chopra, with this award. I, like many others worldwide, feel fortunate to have been mentored by both."

PALEY SELECTED FOR SPECIAL RECOGNITION AT DIVISION OF RESEARCH EVENT

More than 200 UMD faculty scholars and researchers were honored on March 28 at the 2023 Maryland Research Excellence Celebration. The event was co-hosted by Senior Vice President and Provost Jennifer King Rice and Vice President for Research Gregory F. Ball. Honorees were nominated by the deans of each school or college for demonstrably elevating the university's research visibility and reputation.

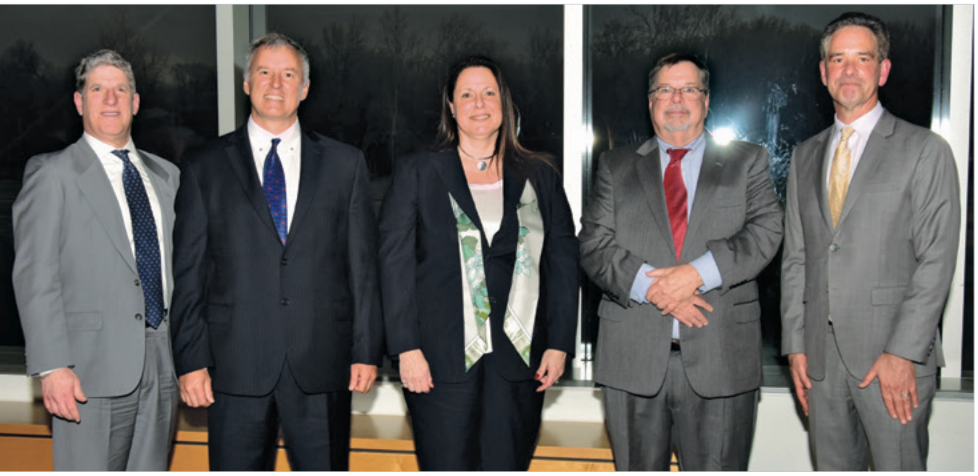
One faculty member from each school or college was selected for special recognition as having best exemplified research excellence.

Willis H. Young, Jr. Professor Derek Paley (aerospace engineering/Institute for Systems Research) was selected to represent the Clark School of Engineering. Paley is the director of the Maryland Robotics Center (MRC) and also directs the Collective Dynamics and Control Laboratory, which conducts research in engineering dynamics and control, particularly autonomous vehicles and sensor networks.

He was honored for a number of recent accomplishments. Paley led the creation of the Robotics and Autonomous Systems undergraduate minor, which launched in 2021, and the opening of MRC's labs in the Iribe Center and IDEA Factory. He is principal investigator of the 5-year $68M ArtIAMAS cooperative agreement with the Army Research Lab on AI and autonomy; ArtIAMAS supports more than 50 faculty members and 120 students across seven universities. Paley is the faculty advisor of the UMD Autonomous Micro Air Vehicle Team, which won first place in the NIST First Responders UAS Indoor Challenge this year, having also taken first place in a similar NIST challenge in 2021. He received the 2020-2021 UMD Distinguished Scholar-Teacher Award and has been selected as a UMD University Honors Faculty Fellow for 2023-2025.

Paley, left, receives his award from Vice President for Research Greg Ball.

Aerospace Engineering Inducts Class of 2023 Academy of Distinguished Alumni Members



2023 Academy of Distinguished Alumni Inductees (from left to right) Daniel I. Newman (M.S. '92), Dr. Andreas P. F. Bernhard (M.S. '95, Ph.D. '00), Flavia F. De Veny (B.S. '92), Ronald Luzier (B.S. '72), and Kerry Wisnosky (B.S. '86)

On April 1, 2023, the Department of Aerospace Engineering inducted five new members into its Academy of Distinguished Alumni during a ceremony held at the College Park Aviation Museum.

Dr. Andreas (Andy) Bernhard (M.S. '95, Ph.D. '00) is the Director of Aircraft Design at Sikorsky Aircraft. He is responsible for all technical aspects related to the design of blades, rotors, transmissions, airframes, and propulsion systems, across all platforms.

Previously, Dr. Bernhard was the Chief Engineer for the CH-53K King Stallion providing overall strategic leadership for all technical activities of the CH-53K program, including design development, integration and test, and product improvement roadmaps. Major accomplishments included first flight, first production contract award, and international debut at the Berlin Airshow. From 2013-2015, Dr. Bernhard was the Chief Engineer for the S-97 RAIDER,™ leading the team from critical design review to first flight. From 2008-2013, he was the Chief Engineer for Sikorsky Aerospace Services responsible for all aspects of Aftermarket Engineering.

Flavia De Veny ('92) is a General Management and Operations Executive who has successfully managed numerous divisions and businesses—from ground up builds to turnarounds—over the past 30 years. Her work has resulted in extensive revenue growth, numerous new market penetrations, and large-scale company expansions.

As President & CEO of Camaco-Amvian (P&C), Ms. De Veny managed a $500+M global seating solutions auto supplier with nine manufacturing facilities and 3,200 employees spanning six countries. She effected a wholesale organizational turn-around positioning the company for prudent and profitable growth in eighteen months. Among her many accomplishments, she built the company's entire executive leadership team, increased enterprise value by $200M in three years on a $500+M P&L, achieved an adjusted 3-year EBITDA CAGR of 82%, and rebuilt and improved vital customer and supplier relationships.

Ronald Luzier ('72) has over 40 years of experience in the design, analysis, manufacturing, and testing of aerospace systems.

One of three founders of Swales Aerospace, he helped build the company to a staff of 1,000 with revenue of $200M. He managed technical teams at Swales in support of the Shuttle High Energy Astrophysics Lab and the Gamma Ray Observatory, building thousands of heat pipes, hundreds of composite structural panels, dozens of advanced thermal management systems, and flight mechanisms, and six spacecraft for NASA Goddard.

Daniel Newman (M.S., '92) is a Boeing Senior Technical Fellow in Aircraft Configuration Development and currently serves as the Chief Engineer for Advanced Vertical Lift, in the Phantom Works Division of Boeing Defense Space & Security.

He was an architect of the Transformational Vertical Flight Workshops that catalyzed the urban air mobility and electric VTOL initiatives. He chaired the NATO Industry Advisory Group (NIAG) Study Groups SG-219 (Next Generation Rotorcraft Capabilities), SG-239 (Integrated Sustainability for the Next Generation Rotorcraft), and SG-266 (Joint-Domain NATO Rotorcraft Interoperability and Survivability in a Peer Nation Threat Environment). He also served on National Academies Panels on Propulsion Sciences (2020) and Maneuver (2018).

Kerry Wisnosky ('86) is an aerospace engineer with over 30 years' experience providing leadership in developing space and missile technology for National Security, civilian agency, and commercial customers.

He currently serves as the Chief Operating Officer/Executive Vice President for Quantum Space, a commercial space company at the forefront of developing the infrastructure required to travel through and operate in deep space safely, reliably, affordably, and routinely.

The Academy of Distinguished Alumni was established to honor University of Maryland alumni who have made significant contributions to the field of Aerospace Engineering. In the fall of 1999, the Department of Aerospace Engineering inducted its first four members, as well as aviation pioneer and lifelong UMD supporter, Glenn L. Martin.

VIEW ALL INDUCTEES AT

aero.umd.edu/alumni-industry/distinguished-alumni

Snow, Wind, and Drone Ops

UMD UROC PILOTS AND ENGINEERS HANDLE AUSTERE CONDITIONS WHILE HELPING NOAA WITH SATELLITE CALIBRATION.

The subarctic climate of Nome, Alaska, makes it a great place for sledding, but a challenging one for drone flight. Uncrewed aerial systems are sensitive to extremes of heat and cold, with damage to sensors and electronics possible if precautions are not taken.

Freezing temperatures, ear-biting winds, and predatory wildlife can make things tough for the humans flying the drones as well.

Handling such challenges was job number one for a University of Maryland UAS Research and Operations Center (UROC) team that traveled to the storied Alaskan gold-mining hub as part of an ongoing collaboration with NOAA and the tech firm GeoThinkTank, which has been pioneering a drone-based approach to the calibration of satellites used in sea ice monitoring.

UROC Project Engineer Josh Gaus and Test Engineer Grant Williams made the trip north in March, joining up with NOAA and GeoThinkTank colleagues to carry out the demanding mission.

The team had previously carried out similar tests in the Great Lakes region. While they encountered wintry conditions there, Nome proved to be even harsher. Temperatures at the testing site ranged between -10 and 20 degrees Fahrenheit, with winds gusting from 15-30 knots amid constant scattered snowstorms. And weather wasn't the only problem. The team had to prepare and be on the lookout for dangerous animals such as bears and rabid arctic foxes, while ice breakaways threatened to leave them stranded, in an area without reliable cellular service. "Our crew was subjected to the same austere conditions as the drone we were flying," Williams said. "We had to ensure that our crew and our aircraft alike were equipped to withstand those conditions."

Solutions for safeguarding the crew included bringing an abundance of provisions, as well as first aid and other necessities—"it's important to bring more than you think you'll need, since you can't always predict what's in store," Williams said. At the ground station, a tent made of see-through plastic material was heated with a propane space heater, keeping the pilot and equipment warm. The team utilized several visual observers to watch for low-flying aircraft and wildlife in the area.

Drone operations at the site reflected months of prior preparation. The team began by selecting the right aircraft for the job—a Harris Aerial H6 gas-hybrid multirotor, equipped with an EFI generator that could keep it in the air for hours at a time. Instead of carting around dozens of batteries that would need to be swapped out every fifteen minutes or so, all the team required for energy was a single, 5 gallon tank of gasoline.

To mitigate the effects of cold weather on the sensors and other delicate system components, the team devised an insulation system that featured custom 3D-printed as well as sewn compartments that were heated with exothermic reaction packs.

The measures taken by the team paid off, yielding four days of successful flights and gathering a wealth of data that NOAA can now use to evaluate the potential of a drone-based calibration and validation system.

UROC Project Engineer Josh Gaus (left) and Test Engineer Grant Williams Harris Aerial H6 gas-hybrid multirotor for flight during a mission to Nome, Alaska. The UROC team worked with NOAA and a private company, GeoThinkTank, to test a drone-based approach to validation of satellite data.

Members of the Arion graduate student design team. From left: Ray Shimry Garatsa, Xavier Delgado, Noam Kaplan, Nathan O'Brien, and Nicholas Paternostro. Not pictured: Brendan Egan.

Arion Lands First Place in VFS Competition

UMD STUDENTS' ENTRY ACHIEVES BREAKTHROUGHS IN SPEED, VERSATILITY.

Graduate students from UMD's Alfred Gessow Rotorcraft Center (AGRC) won first place in the Vertical Flight Society's (VFS) 40th Annual Student Design Competition.

Led by Nathan O'Brien, a UMD Clark Fellow, the team took the top spot in the graduate category with its design for a high-speed vertical takeoff and landing (HSVTOL) aircraft. The victory comes with a $2,500 stipend. O'Brien and fellow team members Xavier Delgado, Brendan Egan, Noam Kaplan, Ray Shimry Garatsa, and Nicholas Paternostro will be invited to present their design at the next VFS Annual Forum and Technology Display.

The team submitted designs for a 48,000 lb mixed power tiltrotor, named Arion, that is designed to optimize stability and control while delivering dramatic improvements in speed and efficiency. Named for a mythical horse that once belonged to the god Hercules, the Arion rotorcraft "embodies the immortal dream of VTOL: helicopter-like hover and jet-like cruise," the team said.

Equipped with a custom-designed rotor system, a light-weight airframe, and advanced avionics, it takes advantage of the AGRC-developed X3D simulation tool, which allows engineers to design ultralight yet robust blades made of composite materials.

The students were mentored by AGRC faculty members Dr. Inderjit Chopra, Dr. Anubhav Datta, and Dr. V.T. Nagaraj.

STUDENT SPOTLIGHT

Romeo Perlstein

AEROSPACE ENGINEERING JUNIOR IS CONTRIBUTING TO ADVANCEMENTS IN SPACE ROBOTICS.

Space equipment, like its equivalents on Earth, can require repairs or upgrades. In addition to its defective mirror, for example, the Hubble Telescope has had sensors, scientific instruments, and batteries swapped out during servicing missions. But space servicing can be costly, difficult, and hazardous. Romeo Perlstein, an undergraduate research assistant at UMD's Space Systems Laboratory (SSL), is helping to develop ways to make such tasks easier to accomplish through the use of space robotics.

"In the past, we'd send up a team of astronauts on the Space Shuttle," Perlstein said. "Now it can be done by a robotic spacecraft that has all the tools and knows what to do." Indeed NASA's On-Orbit Servicing, Assembly, and Manufacturing 1 (OSAM-1) mission envisages being able to provide on-demand robotic servicing of any number of orbiting satellites.

Even when human astronauts are doing the work, they might have robot assistants—or "cobots"—helping them. Astronauts could even find themselves wearing certain kinds of robotic systems. "Your suit might come with two robotic arms that can help you move things around," Perlstein explains.

A native of Willow Grove, Pennsylvania, Perlstein credits his childhood love of Legos with getting him interested in building things, ultimately spurring his decision to become an engineer. Arriving at Maryland, he initially planned to focus on propulsion technology, but a stint volunteering at the SSL during his freshman year inspired him to choose space robotics instead. The volunteer position eventually led to the research assistantship he now holds.

In that role, he is assisting with development of an alternative to the current, hand control-based method of controlling robots. Instead of manipulating a joystick, the user will instead be able to move his or her hand freely within a sensor-equipped exoskeleton, which is able to feel forces acting on the robotic arm. In other words, if the user drives the robotic arm into a wall, they will feel it on the exoskeleton. "The idea is that it will track your movements and send this information over to a robotic arm." Perlstein said. "It's a more intuitive approach."

Though space is the context for this research, similar technologies could also be used on Earth to assist with medical applications or physical therapy. Perlstein's specific role on the project involves using augmented reality (AR) and virtual reality (VR) applications to test the exoskeleton's capabilities.

Perlstein, who landed an internship at the Jet Propulsion Laboratory in California this past summer, likes to keep busy. Between his involvement with the SSL and his coursework, Perlstein has a rigorous schedule. Yet he's also managed to remain active in a number of engineering clubs, including Students for the Exploration and Development of Space (SEDS), with whom he's been working to build a liquid rocket, and the UMD Balloon Payload Program, where his contributions include driving team members and equipment to launch sites. On top of that, he plays trumpet for UMD's University Jazz Band. And when he's not busy with the aforementioned pursuits, he likes to draw.

But his core focus remains on hands-on work that could help us make more effective and efficient use of robotics as our species becomes increasingly more engaged with space.

"Developing, building, and controlling robots—that's what interests me the most," he said.

Dungan Wins NDSEG Fellowship

Department of Aerospace Engineering Ph.D. student Sean Dungan has been awarded a National Defense Science and Engineering Graduate Fellowship (NDSEG), joining a select group of students across the nation who have received this highly competitive award from the U.S. Department of Defense.

Sean Dungan

The fellowship, which comes with a full tuition scholarship and mentorship opportunities, will provide Dungan with valuable support as he conducts research related to boundary layer flows.

Originally from Middletown, Rhode Island, Dungan completed his undergraduate studies in aerospace engineering at the Florida Institute of Technology, and it was there that his fascination with fluid mechanics and high-speed aerospace vehicles took hold.

From there, he received the opportunity to come to UMD and conduct his doctoral research under the supervision of aerospace engineering faculty member Christoph Brehm.

"Working in Dr. Brehm's group, I focused my efforts on numerically investigating the complex, multi-physics problem of fluid-ablation interactions in high-speed boundary layer flows," explained Dungan. "The results of these investigations aim to improve the fundamental understanding of boundary layer transition to turbulence in the presence of an ablative heat shield."

Dungan's particular area of focus is on development of new computational methods for accurately and efficiently predicting boundary layer transition onset. Such capabilities are critical in developing sustained hypersonic flight where skin-friction drag and aerodynamic heating increase significantly as a result of the flow becoming turbulent over the vehicle's external surface.

Dungan hopes that his new computational approach skips the costly temporal transient portion of the calculation and strikes the correct balance between simulation fidelity and turnaround time so that designers can use it to improve the design process currently utilized for hypersonic vehicles.

Cianciarulo is Runner-Up for SPIE Award

Aerospace Engineering Ph.D. student Frank Cianciarulo received second place in SPIE's Craig F. Bohren Best Student Presentation Awards, held during the SPIE Smart Structures and Nondestructive Evaluation: Bioinspiration, Biomimetics, and Bioreplication conference last March.

Cianciarulo's paper, "Analysis of an anchoring muscle for pipe crawling robot," explores the radial behavior of pneumatic artificial muscles (PAMs).

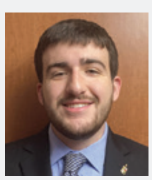
Radial expansion in large diameter (over 2 inches) PAMs has recently been used in worm-like robots to create anchoring forces that allow for a peristaltic wave which creates locomotion through acrylic pipes. By radially expanding, the PAM presses itself into the pipe, creating an anchor point. The previously anchored PAM then deflates, propelling the robot forward.

Frank Cianciarulo (left) was recognized for his paper "Analysis of an anchoring muscle for pipe crawling robot," which explores the radial behavior of pneumatic artificial muscles (PAMs)."

Modeling of the radial expansion forces and anchoring was desired to determine the pressurization required for proper anchoring before slipping occurs due to the combined robot and payload weight.

Cianciarulo's modeling was performed using a force balance approach to capture the effects that bladder strain and applied axial load have on the anchoring force, and radial expansion testing was performed to validate the model. Force due to anchoring was recorded by means of force transducers attached to sections of aluminum pipe using an MTS servo-hydraulic testing machine, and data from the test was compared to the predicted anchoring force for validation. A unified model of the axial and radial behavior was developed to fully characterize the behavior of the PAM during operation.

JONES AWARDED SMART SCHOLARSHIP



Ryan Jones

UMD aerospace engineering undergraduate student Ryan Jones was awarded a U.S. Department of Defense Science, Mathematics, and Research for Transformation (SMART) Scholarship. SMART scholarship awards provide students with full tuition for up to five years, mentorship, summer internships, a stipend and full-time employment with the Department of Defense (DoD) upon graduation.

This unique opportunity offers students hands-on experience at one of more than 100 innovative laboratories across the U.S. Army, Navy, Air Force and larger DoD.

During summer internships, SMART scholars work directly with an experienced mentor, gaining valuable technical skills. After graduation, Jones will work at the U.S. Army DEVCOM Armaments Center in Aberdeen Proving Ground, MD, on the testing of Army projectiles and the development of firing tables and models for use in the field.

Jones is currently studying aerospace engineering, with a minor in project management. In the fall 2023, he began a research project under Associate Professor Stuart Laurence on the testing and analysis of hypersonic projectiles.

Covington, Maher, Receive Maryland Engineering Dean's Awards

TWO DEPARTMENT OF AEROSPACE ENGINEERING STUDENTS WERE AMONG FIVE INDIVIDUALS RECOGNIZED WITH A. JAMES CLARK SCHOOL OF ENGINEERING DEAN'S AWARDS IN SPRING 2023.

William Covington received the Dinah Berman Memorial Award, presented to a third-year engineering student who has combined academic and scholastic excellence with demonstrated leadership or service to the Clark School.

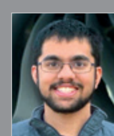
Covington, a senior, co-founded the engineering team SatFab (Satellite Component Fabrication) at UMD. He is also a teaching fellow for ENES100 and performs volunteer engineering work for UMD's Space Systems Lab. This past summer, he held an internship at NASA's Jet Propulsion Laboratory in Pasadena, California as a Mission Planning and Sequencing Intern for the Psyche mission.

Erika Maher received the A. James Clark School of Engineering Leadership Award, presented to a student who has demonstrated outstanding leadership to the Clark School in activities that impact all engineering majors. Maher, who graduated with her B.S. degree in Spring 2023, served for two years as president of the Society of Women Engineers (SWE) chapter at UMD, and as a member of the Women in Engineering Student Advisory Board.

Seven UMD Engineering Students Win VFF Scholarships






When the Vertical Flight Foundation (VFF) announced its scholarship award recipients earlier this year, seven UMD engineering students—including six from aerospace engineering—were among the recipients.

Four of the winners are students of Professor Anubhav Datta. **VICTORIA BRITCHER**, a doctoral student who conducts research on vision-based shipboard landing, received the Dr. Friedrich Straub Scholarship. The Walter Hodgson Scholarship went to **PETER CAPOZZOLI**, a junior working with Professor Datta on eVTOL and Mars Helicopter research. **CATHERINE CATAMBRONE**, who graduated with her B.S. last spring and is continuing on as a Ph.D. student, won the Hal Andrews Scholarship. **NATHAN O'BRIEN**, who conducts research on the study and mitigation of tiltrotor whirl flutter through experimental analysis of the Maryland Tiltrotor Rig, won the Alfred Gessow Scholarship.

Also selected for scholarships this year were junior **GABRIELLE SCHUMACHER** and Ph.D. student **VIVEK UPPOOR**. Schumacher, who has worked in the Composite Research Laboratory (CORE) for the last two years with faculty mentor Dr. Norman Wereley, won the Joseph P. Cribbins Scholarship. Uppoor, who conducts research on high-advance ratio aeroelastic stability of coaxial and compound rotor systems using smart structure actuators, won the Jimmie S. Honaker Scholarship. His mentor is Professor Inderjit Chopra.

A seventh UMD recipient, **COLLEEN M. MURRAY**, is a Ph.D. student in mechanical engineering. She won the Virasak Family Scholarship.

CONGRATULATIONS TO OUR 2023 DEPARTMENT HONORS & AWARD RECIPIENTS

SEVEN AEROSPACE ENGINEERING STUDENTS WERE HONORED IN MAY 2023 FOR THEIR OUTSTANDING ACHIEVEMENTS IN ACADEMICS, LEADERSHIP, AND SERVICE. THE HONORS WERE FORMALLY PRESENTED AT AN ANNUAL CEREMONY HOSTED BY THE A. JAMES CLARK SCHOOL OF ENGINEERING.

The American Institute of Aeronautics and Astronautics Outstanding Achievement Award
ALLEN SCHNAITMANN

The Department of Aerospace Engineering Chair's Award
KRUTI BHINGRADIYA, MICHAEL KALIN, and MADELYNE ROSSMANN



The Department of Aerospace Engineering Gessow Academic Achievement Award
ANISH SANKLA

The Joseph Guthrie Memorial Scholarship Awards
PETER CAPOZZOLI and GUSTAVO LANG, JR.


The Women in Aeronautics and Astronautics Award
MADELYNE ROSSMAN

AT THE FRONTIER OF SPACE TOURISM:
Chris Huie

Adventurers seeking an out-of-this-world experience can now fly into space with Virgin Galactic. In May, the company launched a final test flight before beginning its planned regular launches. On board the VSS Unity was UMD alum Chris Huie '11, one of four crew members who conducted this last assessment of the customer—or "astronaut"—experience, with all of its thrills, luxury and wonderment.

Huie, who first joined Virgin Galactic in 2016 as a Flight Engineer, is among only around 20 Black astronauts to have flown into space—a number he hopes will rise as the industry becomes more inclusive. At Virgin Galactic, he co-founded the company's Black Leadership in Aerospace Scholarship and Training (BLAST) program. We want to create leaders who can understand the Black experience and the challenges that come with it, and who can be in a position to bring about change for the better," he says.

ALUMNI SPOTLIGHT

Duffles Launches Fellowship to Support Aero Faculty

INNOVATION INVOLVES RISK. MARCIO DUFFLES ('83) CAN SPEAK TO THAT FACT FROM PERSONAL EXPERIENCE.

In 1997, Duffles joined a small company, MDS Coating Technology, that was about to take a gamble on a novel coating technology with the potential to dramatically increase the lifespan of turboshaft engines.

At the time, engine companies were not interested. These companies didn't generally want parts to last longer, since part of their business model was based on replacing spare parts. "It would be like creating a razor blade that doesn't wear out," Duffles said. "It didn't make much sense from a business point of view.'

But the U.S. Naval Air Systems Command was interested. During Operation Iraqi Freedom, the U.S. Marine Corps replaced the turboshaft engine on their CH-53 helicopters after only 100 hours of operation. The first coated engine was delivered in 2003 and operated for over 2,000 hours in the Iraqi theater! Altogether, the technology has saved NAVAIR over a billion dollars in maintenance costs. In 2007, MDS Coating received the Harry T. Jensen Award from the American Helicopter Society (today known as the Vertical Flight Society) for "outstanding contribution to the improvement of vertical flight aircraft reliability, maintainability and/or safety through improved design."

Today major commercial carriers like Delta Air Lines operate with coated engine compressors that retain engine performance and, hence, extend engine life, reduce fuel consumption and emissions. MDS continues to refine the technology and is collaborating with UMD aerospace engineering faculty members Dr. Jim Baeder and Dr. Christoph Brehm in conducting computational fluid dynamics analysis to quantify the benefits of coated turbofan blades as part of the FAA's Continuous Lower Energy, Emissions and Noise (CLEEN) program.

In part, because of his own experience, Duffles likes to see engineering researchers push the boundaries and explore new avenues to advance the field, despite the risk that not all their explorations will bear fruit. That's the intention driving the new Aerospace Board of Visitors (ABOV) Faculty Exploration Fellowship, which Duffles, an ABOV member since 2018, recently launched with a gift to support junior faculty, and enable professors to go outside campus and the classroom, attend professional seminars and other avenues of professional interaction, and further develop their interests.

Duffles pledged the gift to UMD as a tribute to his late mother, Luisa Duffles. "She raised three kids and stressed the importance of education on a daily basis," he said. It was a lesson her children took to heart. After emigrating from their native Brazil, Duffles and his brother both earned engineering degrees (aerospace and chemical, respectively) at Maryland; his brother then went on to medical school, also at Maryland. Their sister, meanwhile, majored in microbiology, first at Maryland and then at St. Mary's College.

Luisa Duffles, who double-majored in accounting and journalism, was herself a pioneer. At that time in Brazil, a university education was a rarity for women. As he was sorting through her belongings after her death earlier this year, Marcio Duffles came across his mother's 1949 college yearbook. She was the only female graduate.

Today, her legacy continues through the success of her children, and through a fellowship that Duffles hopes will help his alma mater—already a national leader in aerospace engineering—soar to new heights.

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PHOTO: LEE GILLENWATER

CONGRATS TO THE UNIVERSITY OF MARYLAND AMAV TEAM!

The UMD Autonomous Micro Air Vehicle (AMAV) team beat out ten fellow competitors in the final round of NIST's First Responder UAS Indoor Challenge to bring home the grand prize and $150,000. They also scored four out of the six Best-in-Class awards. In August, Representative Glenn F. Ivey (D-MD) presented members of the team with a proclamation during a special ceremony held at the Maryland Fire and Rescue Institute (MFRI) to commemorate their achievement—the team's second successive win in a NIST challenge of this kind. From left: UMD President Darryll J. Pines, AMAV team lead Animesh Shastry, AMAV team design lead and pilot Qingwen Wei, U.S. Representative Glenn F. Ivey, Maryland Robotics Center Director Derek Paley, UMD UAS Research and Operations Center Project Engineer Josh Gaus, and A. James Clark School Dean Samuel Graham. Jr.

LEARN MORE: amav.umd.edu