Q&A 12
FAA's air traffic chief on incursions

HUMAN EXPLORATION 28
Will we ever settle on Mars?

Launch regs in the Trump era
PAGE 34

AEROSPACE AMERICA

Can Kwaj survive?

Climate change suggests a messy and expensive future for this U.S. test site that's central to plans for countering the weapons of China and others. Here's the early thinking about what to do.

PAGE 22

JANUARY 2025 | A publication of the American Institute of Aeronautics and Astronautics | aerospaceamerica.aiaa.org

AIAA
SHAPING THE FUTURE OF AEROSPACE

ASCENDxTexas

26–27 FEBRUARY 2025 | HOUSTON, TEXAS

Strategic Transitions — Aligning Stakeholders for Giant Leaps

Mark your calendar and join hundreds of decision makers and industry influencers from NASA, academia, government, and private entities to work on solutions that advance the space ecosystem and revolutionize our off-world future.

In this year of political, strategic, acquisitional, and mission-driven transitions, 2025 ASCENDxTexas will focus on the innovation and adaptation necessary to navigate the evolving space economy — from policy discussions to commercial challenges and changing timelines, the next giant leap starts here.

KEYNOTE SPEAKERS:

AMIT KSHATRIYA
Deputy Associate Administrator
Moon to Mars Program
NASA

JOEL MONTALBANO
Deputy Associate Administrator
Space Operations Missions Directorate
NASA

FEATURED SPEAKERS:

TIM CRAIN
Chief Technology Officer
Intuitive Machines

TIM KOPRA
CEO
Starlab

KELLY PAGE
Chief Executive Officer
Barrios

IN PARTNERSHIP WITH

BAY AREA HOUSTON Economic Partnership

REGISTER TODAY

www.ascend.events/ascendxtexas

Powered by AIAA

Kwajalein Island, home to the U.S. Army garrison that runs the Ronald Reagan Ballistic Missile Defense Test Site is the largest of Kwajalein Atoll's 100 islands. Climate scientists have identified this and other atolls in the Marshall Islands as particularly vulnerable to sea level rise. This image was taken by Maxar Technologies' WorldView-2 satellite.

Maxar

ON THE COVER: A target missile is launched from Kwajalein Atoll in a 2010 test of the U.S. Ground-Based Midcourse Defense System. Missile Defense Agency

AEROSPACE
AMERICA

JANUARY 2025,
VOL. 63, NO. 1

EDITOR-IN-CHIEF
Ben Iannotta
beni@aiaa.org

ASSOCIATE EDITOR
Cat Hofacker
catherineh@aiaa.org

STAFF REPORTER
Paul Brinkmann
paulb@aiaa.org

EDITOR, AIAA BULLETIN
Christine Williams
christinew@aiaa.org

CONTRIBUTING WRITERS
Keith Button, Jonathan Coopersmith, Mike Gruss, Moriba Jah, Aaron Karp, Jon Kelvey, Paul Marks, Jonathan O'Callaghan, Robert van der Linden, Debra Werner, Frank H. Winter

Daniel Hastings AIAA PRESIDENT
Clay Mowry PUBLISHER

ADVERTISING
advertising@aiaa.org

ART DIRECTION AND DESIGN
THOR Design Studio | thor.design

MANUFACTURING AND DISTRIBUTION
Katrina Buckley | katrinab@aiaa.org

LETTERS
letters@aerospaceamerica.org

CORRESPONDENCE
Ben Iannotta, beni@aiaa.org

Aerospace America (ISSN 0740-722X) is published monthly except in August by the American Institute of Aeronautics and Astronautics Inc., at 12700 Sunrise Valley Drive, Suite 200 Reston, VA 20191-5807 [703-264-7500]. Subscription rate is 50% of dues for AIAA members (and is not deductible therefrom). Nonmember subscription price: U.S., $200; foreign, $220. Single copies $25 each. Postmaster: Send address changes and subscription orders to Aerospace America, American Institute of Aeronautics and Astronautics, at 12700 Sunrise Valley Drive, Reston, VA, 20191-5807, Attn: A.I.A.A. Customer Service. Periodical postage paid at Reston, Virginia, and at additional mailing offices.

AIAA
SHAPING THE FUTURE OF AEROSPACE

IN THIS ISSUE

Keith Button

Keith has written for C4ISR Journal and Hedge Fund Alert, where he broke news of the 2007 Bear Stearns hedge fund blowup that kicked off the global credit crisis. He is based in New York. PAGES 10, 18

Mike Gruss

Mike was appointed chief content and strategy officer of SpaceNews in December. Previously, he was editor-in-chief of Sightline Media Group, where he led publications including Defense News and Military Times, and was the military reporter at SpaceNews. PAGE 22

Moriba Jah

Moriba is a space environmentalist, professor at the University of Texas at Austin and chief scientist at Privateer. He helped navigate spacecraft at NASA's Jet Propulsion Lab and researched space situational awareness issues at the U.S. Air Force Research Laboratory. PAGE 60

Jonathan O'Callaghan

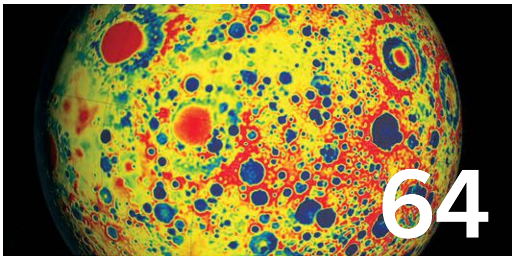
Jonathan is a London-based space and science journalist covering commercial spaceflight, space exploration and astrophysics. A regular contributor to Scientific American and New Scientist, his work has also appeared in Forbes, The New York Times and Wired. PAGE 34

Debra Werner

A longtime contributor to Aerospace America, Debra is also a correspondent for Space News on the West Coast of the United States. PAGE 28

DEPARTMENTS

AD INDEX



IN THIS ISSUE:

From Kwajalein to Mars in 40 pages

I've never been to Kwajalein Atoll, but after reading our cover story, I feel like I have.

The climate aspect of the story [page 22] made me recall that the U.S. Navy long ago realized that a new navigable sea is emerging in the Arctic. The services that rely on Kwajalein might be on the cusp of their own epiphany: that rising waters mean the outpost's usefulness for military testing won't be perpetual.

Like any well-done story, the piece also gave me an idea for a possible follow-up. Perhaps the "best days" do in fact lie ahead for the atoll, as one interviewee in the story says. Just in case, it could be wise to brainstorm alternatives, if the Pentagon is not already doing so. China, for example, has created artificial islands in the South China Sea, so couldn't the key islands in Kwajalein be buttressed similarly? Reefs elsewhere could be protected or restored to compensate for any environmental damage. What about building floating platforms or barges to launch targets and host radars or telescopes? The U.S. Missile Defense Agency has the floating Sea-based X-band Radar, a golf-ball-looking radome on an elevated platform. There was also the short-lived international Sea Launch consortium that launched rockets and satellites from a mobile platform.

Turning to my interview with Tim Arel, head of FAA's Air Traffic Organization [page 12], I hope we here in the United States always permit someone who excels at a specific skill to reach such a high level without a bachelor's degree. The timeliness for the interview was the spate of runway incursions experienced in the U.S. in the months coming off the pandemic and the shortage of controllers in some locations that FAA is working to solve.

The interview reminded me that when fallible human beings are brought together as a well-equipped and managed team, the result is something efficient and powerful, in this case "a beautiful movement of aircraft," as Arel calls it. While FAA is not always noted for its agility — See for example, "Permission to launch" on page 34 — it snapped into action with a series of policy and technology initiatives to address the close calls at U.S. airports. I came away reassured but also wondering if there's a limit to how much throughput our airports, the skies and workers can handle.

Also in this issue, we've introduced a revamped version of "The Big Question," a department where we ask experts in a particular field to opine about a specific question, in this case, "Will humans ever permanently settle on Mars?" [page 28] If nothing else, the answers show that settling Mars will require much more than building the rockets and spacecraft to take people there. Expertise beyond aerospace engineering will be required, including in the medical, mental health and food cultivation realms. ★

Ben Iannotta, editor-in-chief, beni@aiaa.org

Meet Your AIAA Candidate for President-Elect

Dana "Keoki" Jackson

CURRENTLY: Senior Vice President and General Manager, MITRE National Security Sector, responsible for the strategic growth and execution of programs supporting Department of Defense, Department of Justice, and the Intelligence Community. He also leads the National Security Engineering Center.

NOTABLE: Jackson joined MITRE after more than two decades at Lockheed Martin, where he shaped the design, development, deployment, and flight operation of major national security spacecraft and programs. Before joining Lockheed Martin, Jackson was a NASA research fellow at the Massachusetts Institute of Technology (MIT) in the field of human adaptation to the space environment. Jackson is an AIAA Fellow and a Fellow of the United Kingdom Royal Aeronautical Society. He was elected to the National Academy of Engineering in 2020.

AIAA RECORD: Joined the Institute in 1995; Class of 2019 AIAA Fellow. Life Sciences and Systems Technical Committee Member (1999–2003); AIAA Foundation Board Trustee (2015–2020); AIAA Board of Trustees Member (2023–2026 term); and Finance Committee Member (2023–present).

EDUCATION: Bachelor's, Master's, and Ph.D. degrees in aeronautics and astronautics from MIT. Completed the Stanford Executive Program at the Stanford Graduate School of Business.

What sparked your interest in aerospace? How did you get into this line of work?

I've been an aviation and space nerd since I was a kid. In grade school, I followed the Voyager missions and saw the images coming back from the outer planets. I kept up with the Space Shuttle development and I remember very clearly watching the first drop tests. Those were formative memories. And although I wasn't old enough to take the FAA private pilot exam, I had taken the class and done all the testing, just couldn't do it for a score.

Then it was a freshman year seminar course at MIT that opened my mind to the breadth of things you could do in aerospace engineering and scientific research, and I went full force into aerospace.

What was your career path?

My work has focused on national security systems, secure communications for the military, GPS, and missile warning systems. I've led the development of these systems and worked very closely with the operators. I've spent quite a bit of time on technology development as CTO, leading the R&D efforts for Lockheed Martin. I've had the chance to work across a whole range of products from hypersonics, high-speed flight, and security of our space systems to where we're going in the future with highly distributed systems and defending the national security spectrum. These were opportunities to shape the direction of where we were going as a nation.

At MITRE I'm working very closely with the U.S. government, and I lead the National Security Engineering Center (NSEC). I sit at the intersection of R&D investments, not just on things that fly but how to integrate all these systems to make a difference; reliable position, navigation, and timing; getting assured communications across all domains; having the intelligence surveillance and reconnaissance provided by incredible aerospace systems; and all the connectivity that makes it work together.

What was your experience with AIAA as a student, young professional, and now?

From my early days through student branch involvement and many events I have attended, AIAA has been with me. I look back on my time as a student with AIAA and remember the amazing opportunity to interact with individuals like Neil Armstrong and Buzz Aldrin, the heroes and legends of the Apollo era, who were engaged with AIAA.

As I got into my research program, I served on the Life Science and Systems Technical Committee which was eye-opening. A lot of times you're really immersed in your research in the lab. To take a step back and engage with some brilliant people who are connected globally, who have a vision of where this piece of research is going, was really inspiring to me. AIAA conferences were another opportunity to be a part of shaping where we were going in that technology area.

In grad school, I worked on two Space Shuttle missions on experiments, testing astronauts to see how they adapted to the space environment and how they readapted when they come back to Earth. I spent time at NASA Johnson Space Center and Cape Canaveral preparing astronauts for their missions and testing them when they came back. Those were amazing opportunities to engage with my research teams and others who were members of AIAA.

As my career progressed, I was a part of more development work and that led me back to AIAA in more senior roles. I could see the value in what the Council of Direc-

BY AIAA Communications

Each AIAA President-Elect helps guide the Institute, first as a member of the Board of Trustees and then as President beginning a year later. For the 2025 general election, Keoki Jackson of The MITRE Corporation is running unopposed and will become President-Elect in May. We spoke to Jackson about his career experience and his vision for AIAA.

tors and AIAA Regions were doing through the events being hosted in different parts of the country.

Why do you have such a passion for the AIAA Foundation?

I spent time as a Foundation Trustee with other Corporate Members working to get corporate donations to support activities focused on uplifting future AIAA members. The Foundation is focused on STEM development and bringing students and educators to a wide range of activities that will inspire the next generation.

I'm deeply grateful to Lockheed Martin for their incredible support to the AIAA Foundation, and recognize Northrop Grumman, Raytheon, Boeing, and many more, who have invested in it. The big corporate donations are important to sustain the Foundation for the future. But the Foundation is the members; it's the everyday donations from individuals who care what's going to happen next in aerospace, who are looking at the next generation. A big shout out to our members for their continued support of the Foundation!

In your election statement, you talked about engaging AIAA volunteers and staff through four focus areas. Can you elaborate on how you will do this?

My role as President-Elect and President is an opportunity to support our staff and our volunteers with what they're doing every day, and to shine a light on the important work that AIAA is doing. We also need to get AIAA on sustainable, long-term financial footing, and increase engagement with volunteers, aligning their activities to the overall mission and improving their leadership development. I broke this work into these four areas:

1. **Strengthening partnerships with industry, government, and academia that enable the Institute and the AIAA Foundation.** The opportunities for our members are inherently linked to the engagement and support of these organizations. As we increase those partnerships, we'll increase the leverage and advantage for AIAA and, ultimately, for the development of our members and the impact that they have on the missions they're supporting every day. We're going to have to build ties with new people and the many new startup companies. What can AIAA do to make this next generation of organizations a success? We need to bring them into our ecosystem and show them how AIAA is relevant to them.

2. **Building our international stature.** AIAA is the premier aerospace professional society in the world, but we are largely U.S. centric. There's an incredible opportunity to get our vision and value proposition out there globally and partner with organizations such as IAF, ICAS, the Royal Aeronautical Society, and similar organizations in other countries, who are creating incredible new capability and capacity, and encouraging research and development partnerships.

3. **Championing our members, and particularly the growth and development of our members and diversity initiatives.** We aspire to be an organization that reflects the society that we live in. I see a few ways to do this – increasing visibility with other organizations, like the National Academies, that are devoted to similar professional and STEM development, and also reaching out to the breadth of academic organizations that are creating the next generation of talent. We also need to do everything we can to support the Foundation's efforts to develop the future workforce pipeline.

4. **Recognizing our members' impact across sponsoring organizations.** A lot of what AIAA does is shine a light on the incredible work that our members do and how it impacts society, our citizens, and health, safety, and prosperity around the world. Our Board of Trustees and volunteer leaders can amplify these honors and our message to shine a light on what AIAA is doing and what our members are doing, which inspires even more people to take on the challenges of the aerospace industry.

AIAA, like many professional societies, has faced membership and financial challenges. How does the Institute turn that around?

All professional organizations have seen changes in their membership and have had problems recruiting and retaining members, resulting in financial challenges. Additionally, the pandemic disrupted conferences and big events. I have to recognize the tremendous work by Dan Dumbacher and the disciplined work by the Board of Trustees and our volunteers over the past few years. We've seen a better-than-expected turnaround in some of the financial challenges, so kudos to the team. There's tremendous excitement about the future of aerospace and we need to grab hold of that to grow. We should examine our relevance for the membership and the challenges they face today.

What do you think would mark a successful presidential tenure?

I see it as 1) supporting the AIAA CEO and staff in implementing the strategy; 2) getting greater visibility across all the institutions that support AIAA that fund aerospace research and development, including the U.S. government and Congress but also our international partners; 3) forming new international partnerships with like-minded organizations that take our profession to new heights; and 4) providing more opportunities and more venues to showcase the impact that our members are having every day on billions of people around the world. ★

Creating a dataset for autonomous air taxi training

BY PAUL BRINKMANN | paulb@aiaa.org

NASA aerospace engineer Nelson Brown watched a computer display at NASA's Kennedy Space Center in Florida as multiple video streams showed views from a pod slung beneath a helicopter flying over the center's landscape.

Brown is the lead researcher in NASA's AIRVUE initiative, short for Airborne Instrumentation for Real-world Video of Urban Environments. The pod gathered video, laser range finding and other flight data. This kind of information from flights beyond KSC could one day populate a dataset of actual flight scenarios that developers of electric air taxis could tap to train their aircraft to fly autonomously with onboard software. Analysts have often said that avoiding the need to train and pay numerous pilots could be essential for air taxi services to become widespread and profitable.

The November flight monitored by Brown was one of the last in an initial test phase of AIRVUE that concluded that month. One of KSC's conventionally piloted Airbus H135s that are normally flown for security operations was fitted with the pod containing off-the-shelf cameras; a light detection and ranging sensor, or lidar; and an inertial navigation system unit consisting of a GPS receiver and an inertial measurement sensor to determine the aircraft's attitude. With this combination, the videos and any images extracted from them were matched with the aircraft's location, altitude, airspeed and attitude.

KSC was adequate for the testing, Brown says, even though it doesn't look much like the urban places where air taxis are expected to fly. There are some features, including a helipad and launch towers off in the distance. Most significant, though, were the birds.

▲ NASA plans to create an open-source dataset of flight scenarios for electric air taxi developers to train their aircraft to fly autonomously. During initial flights at NASA's Kennedy Space Center in Florida, the pod carried by this Airbus 135 collected video and other flight data.

NASA/Isaac Watson

▲ The pod for NASA's Airborne Instrumentation for Real-world Video of Urban Environments, or AIRVUE, initiative was constructed early last year at NASA's Armstrong Flight Research Center in California. The pod was tested on drones before being brought to NASA's Kennedy Space Center in Florida for the helicopter flights.

NASA/Genaro Vavuris

Encounters with them were especially valuable, Brown explains, because they are obstacles to be avoided. These encounters were annotated manually in the dataset so that a person or a computer could later learn how the aircraft maneuvered in response.

To elaborate on the need for AIRVUE, Brown offers a comparison to the auto industry: The self-driving car company Waymo, owned by Google's parent Alphabet, has collected vast amounts of video from the autonomous taxis it operates on city streets in Los Angeles, San Francisco and Phoenix. The video and still images are overlaid with driving data such as location and speed, all of which is annotated by humans to identify specific threats or obstacles. Other companies and researchers can download Waymo's open-source dataset and train their own software to recognize hazards on the road, Brown points out.

While Waymo is permitted to operate its vehicles on city streets, autonomous air taxis probably won't be able to learn by flying in crowded, three-dimensional airspace without traffic signals. Hence, AIRVUE: "I really want to get a large airborne dataset curated by NASA and available for public use," Brown says.

It would be open source so that researchers and developers of air taxis can access it and conduct additional research or train their aircraft to fly without a pilot on board.

Among the first orders of business when the initiative began in 2022 was to decide which cameras to include in the pod. NASA conducted standard risk-reduction flights that year at KSC to evaluate commercially available cameras and their responses to vibrations and other factors. Brown and others then went back to their home base at NASA's Armstrong Flight Research Center in Southern California to create the pod and test it on drones there before returning to KSC to start the first pod flights.

AIRVUE is just a first step in collecting data for airborne computer vision, and Brown doesn't expect that NASA will be able to collect enough data to ensure accurate computer vision for flights in widespread urban areas. He says that the agency expects others, including in the private sector, will eventually contribute to the dataset.

Ultimately, the goal is to have software capable of recognizing potential hazards such as power lines, rogue aircraft that are not where they are supposed to be, weather balloons, large birds, hailstones and other weather phenomena, or even ground hazards such as people walking across landing pads, Brown says.

That means others beyond KSC must gather and share video too. "NASA would offer the pod to helicopter operators that are already flying in cities and partner with them to kind of crowdsource video" and other types of data, Brown says.

Also, air taxi companies could be given the design of the pod and the data specifications so they can build their own pods and share flight data to expand the depth of the airborne dataset. When air taxi companies start flying commercially, NASA could also partner with them, he says.

Right now, AIRVUE is funded through 2027, and there's much to do between now and then. Plans call for the next round of flights to begin "in the spring timeframe," NASA tells me, after which the pod will be redesigned to eliminate the lidar sensor.

"We want to really slim down the bulkiness of the pod and get it approved by FAA for several types of aircraft," Brown says.

Those who monitor progress toward autonomous flight have long called for development of an airborne dataset, says Ella Atkins, a professor of aerospace engineering at Virginia Tech and editor-in-chief of AIAA's Journal of Aerospace Information Systems.

"It is in everyone's best interest to share data so the [machine learning] training can be as comprehensive as possible. Kudos to NASA for taking this initiative," Atkins tells me.

She says the AIRVUE dataset could also help train pilots if fed into simulators that mimic flight conditions. She notes that autopilot functions on today's airliners or corporate jets aren't relevant to electric air taxis that will spend most of their flight time at lower altitudes, closer to ground-based obstacles and birds, and perhaps far from tightly controlled airspace around airports.

Most importantly, she says, is that NASA and FAA encourage the recording and reporting of "corner cases," unusual scenarios where something goes wrong and aircraft are forced to maneuver suddenly to avoid calamity.

"It is super important that NASA work with FAA to ensure no organization that contributes data can be found liable for breaking rules," Atkins said. "We want this AIRVUE dataset to have the problematic data. If not, it will be good for training but will fail to inform in the event of pilot error, sensor failure, bad weather, rogue aircraft, etc." ★

Smart satellites for fast action

BY KEITH BUTTON | buttonkeith@gmail.com

▲ Ubotica of Dublin wants to demonstrate that artificial intelligence agents aboard its CogniSAT-6 cubesat can detect events like floods or erupting volcanoes and direct the satellite's camera to take images of them. Satellites with this dynamic targeting ability could get images of unfolding disasters more quickly to scientists and first responders.

Ubotica

Scientists, first responders and environmental watchdogs are smart, but not smart enough to always predict where a volcano will erupt, a wildfire will break out, an algae bloom explode or a ship will illegally flush its bilge. By the time any of them put in a request to a satellite operator and receive images of the scene, hours to days have passed.

"Not only have you provided something that's of no use to the end client, you've also wasted the valuable compute and power budget of the satellite," says Fintan Buckley, CEO of Dublin-based Ubotica, a satellite software developer that's among those aspiring to arm satellites with artificial intelligence to solve this problem.

Under a $632,000 contract with the NASA-funded Jet Propulsion Lab in California, Ubotica plans to demonstrate dynamic targeting. That's when a satellite's camera or cameras look ahead on the satellite's path to automatically detect and focus in on an unfolding event as the spacecraft passes over it. According to Steve Chien, co-head of the AI group at JPL, the only satellite publicly known to do this is GOSAT-2, Japan's Greenhouse Gases Observing Satellite.

Starting at a date-to-be-decided this year, two of JPL's various AI agents on board CogniSAT-6, a 6-unit cubesat that was launched in March, will attempt to autonomously spot and redirect the satellite to take high-resolution images of "thermal anomalies" that indicate volcanic activity or wildfires. If they can do so, the feat would mark a step beyond experiments conducted in October, November and December. The same agents, along with additional ones from JPL and Ubotica, recognized specific events in images, including flooding in Spain and ships at sea. The difference was that no attempt was made to redirect the satellite. For its part, Ubotica's AI "within minutes" identified 142 ships outside the port of Khor Fakkan in the United Arab Emirates by analyzing a single image.

Here's how the coming trials will work: CogniSAT-6, operated by U.K. company Open Cosmos, will fly toward general target areas, such as a volcanically active region, to see if the JPL agents can detect the activity. The single full-light-spectrum camera on the satellite will look ahead and take images. JPL has trained all of its AI agents to look for specific features, such as visible infrared light emanating from a volcanic area. During the trials, the agents will run on Ubotica's SPACE:AI software and hardware to analyze the lookahead images.

If an agent finds the specific feature it is looking for, it will have 50 seconds from the time the lookahead image is shot to redirect the camera to take a more fine-tuned image as the satellite passes over the target at 7.5 kilometers per second. The 50-second goal would beat the 2024 trials, in which the agents needed 10 minutes to analyze the images.

JPL is planning additional trials with the other AI agents, also at a date to be determined. Among them: Two agents that have been trained to spot clouds and identify storms will be tasked with determining whether clouds are obscuring the satellite's field of view to the point that photographs should not be taken. These agents will also be tested on their ability to locate storms and take high-resolution photos of them from an altitude of 500 kilometers, which allows for more detailed photos than those by NOAA's geostationary satellites that are locked in orbits above the equator at 35,000 kilometers up.

All of the lookahead and overhead images will be saved so JPL's scientists can evaluate the agents.

Future iterations of dynamic targeting could employ satellites with a second, low-power lookahead camera, or analyze images captured by other satellites, such as NOAA satellites in the storm imaging scenario, Chien says. ★

FAA

Chaos tamer

Tim Arel's task is to lead FAA's 14,000 controllers and the flying public through what might be the most challenging era in the history of the Air Traffic Organization, the 24-year-old arm of FAA he oversees. Coming out of the pandemic, U.S. travelers were rattled by a series of narrowly averted airliner collisions. Now, a shortage of controllers could complicate efforts to sustain the decline in runway incursions seen since 2023. Arel spoke with me by video about the initiatives he launched to address incursions and also fill ATO's hiring pipeline; about whether the planned Department of Government Efficiency, or DOGE, can help; and what kind of people make great controllers. — *Ben Iannotta*

TIM AREL

POSITIONS:

- 2022-present, chief operating officer of FAA's Air Traffic Organization, the top job at ATO
- 2022-2024, chair of the Latin American and Caribbean CANSO CEO Committee (CANSO stands for Civil Air Navigation Services Organisation)
- 2017-2022, deputy chief operating officer in charge of domestic air traffic operations and manager of ATO Officers Group
- 2015-16, vice president in charge of the Air Traffic Services unit
- 2015, deputy vice president in the Air Traffic Services unit
- 2013-2015, deputy vice president in the Safety and Technical Training unit
- 2010-2013, manager of the Air Traffic Control Investigations Team
- 1989-2010, air traffic controller
- 1985-1989, U.S. Air Force air traffic controller specialist reaching rank of sergeant

NOTABLES:

- Between shifts as an FAA air traffic controller, worked as a police officer, emergency medical technician and 911 operator in Uxbridge, Massachusetts.
- Leads the organization that comprises two-thirds of FAA's personnel.
- In 1999, while listening back to controller conversations, discovered a near collision at T.F. Green International Airport in Rhode Island that led to an NTSB investigation.
- Enlisted in the U.S. Air Force at 17.

AGE: 57

RESIDES: Arlington, Virginia

EDUCATION: Graduate of the Air Force Air Traffic Control School and the FAA Academy in Oklahoma. Holds certificates from the Leadership for a Democratic Society program of the Federal Executive Institute and from the Driving Government Performance program at Harvard's Kennedy School of Government. Has completed approximately two years of college courses over the years.

Q: Let's start off by looking back to look forward. How did your time as a controller differ from what controllers experience today?

A: We didn't have as many automated support tools, and we were not as advanced in managing our flows of traffic, collaborating with industry in real time. So there were greater amounts of uncontrolled demand and lots of starts and stops based on surges of traffic. Now, it is more metered. It certainly is as busy as it ever was. Overall, the basic job — the separation of aircraft, particularly in the terminal environment, where I worked — is still the same.

Q: When you were a controller, were there any runway incursions that you recall?

A: As a matter of fact, while I was a quality assurance specialist and responsible for conducting safety investigations, one of the more serious runway incursions prior to the ones we've experienced in the last few years was in Providence, Rhode Island, where a US Air on a foggy day was repeatedly cleared for takeoff, while a United was lost out on the runway. You may remember a FedEx had just taken off. There was a big NTSB [National Transportation Safety Board] investigation. I'm the one who found that event and reported it, investigated it.

Q: Wow. How did you find it?

A: We had something unusual happen the night before. I went and listened to our recordings. We didn't have the proactive reporting that we have now. One of the things I'm most proud of is our transparency now. When mistakes are made, no matter who made them, we encourage proactive reporting. As long as someone is honest and there was no active negligence, we don't punish them. We want them to fully disclose, in a protected environment, anything that may have occurred. We learn from that, and we build mitigations in.

He's referring to the Air Traffic Safety Action Program started in 2008 to shift controllers into a Just Culture quality management approach. — B.I.

The reason why we have close calls and not an unfortunate accident is because we have layers of mitigations in place between the flight crew, the air traffic personnel, the technology. People can make mistakes, but you have alarms or barriers or things that trigger that reporting or reaction for someone to step in and take action, which is why, overall, the number of runway incursions is trending down slightly. The majority are our lowest of classifications. There's a line stopping you from entering the runway or telling the pilot not to go beyond that line. There are times where an airplane is taxing and going just over the line. And if the controller says "stop" on the radio or the pilot realizes they've taxied too far, but they're over the line, it's still a runway incursion — but they didn't actually enter the runway. When I was a controller in the field, they changed that. It used to be that you had to actually enter the runway. Once it became, "you go over the line," our number of runway incursions went up. So for the last 20-something years, it's a big spike from the previous time before. Now, an incursion is from "no chance of collision" all the way to the ones that are close calls.

Q: So the change wouldn't have affected the recent spike in incursions.

A: No. In the most recent spike, there were two things that occurred. One, you had our recovery from covid. As we ramped operations back up, the number of incursions also went up at a steady rate associated with that. But what we saw in the last couple of years was a rise in potentially significant runway incursions: category As and Bs. There has been no one thing anybody could point to. That's why FAA did a Call to Action. We had a Safety Summit we stood up out at MITRE. We identified several approaches to deal with that issue. The rise, though, I would attribute to an increase in high-tempo operations. There are things that are just basic practices and — I don't want to call it rustiness — but there was a lull in

"We're always going to have humans in the loop, at least for the foreseeable future."

▲ FAA's Air Traffic Organization has the task of maintaining safe and efficient operations as the number of passenger flights continues to grow. Atlanta's Hartsfield-Jackson International Airport was the busiest airport in the world in 2023, recording 104.7 million passengers and 7775,818 arriving and departing aircraft.

Darryl Brooks via Shutterstock

operations during covid, and now it was back strong. A high-tempo airport is something amazing to watch: people choreographing the movement of an aircraft, and if the controller or the pilots are not in tune with what's happening, and if something's out of sync, it's easy for mistakes to occur.

Q: What help can AI be in all this?

A: AI, for us, is something that is already present in our systems to a degree. As you know, a lot of people are mystified by AI. They're intimidated. They don't realize that a lot of it is doing high-speed computing, looking at a lot of historical data and applying a decision-support tool. We're always going to have humans in the loop, at least for the foreseeable future, when it comes to separating aircraft or routing around weather or choosing our optimal rate or configuration of an airport or of any piece of airspace. However, controllers benefit from any information that can be provided to them in a timely fashion, whether it's recognizing a conflict and alerting the controller or providing alternative tasks. In other words, here's the conflict. Here are two or three options, and the controller can choose. In the en route world, where aircraft are moving at high altitudes on set trajectories, you have time to recognize conflicts. That timeline becomes very narrow as you come closer and closer to that airport environment where airplanes are operating in a close geometry. So there are tools like our Surface Awareness Initiative, where we're using the ADS-B [Automated Dependence Surveillance, Broadcast] equipage mandate that you don't have to have traditional radar to see everything anymore. If people are emitting a signal, it tells you a lot of information about that aircraft. We deployed that situational awareness tool in less than 12 months from the Safety Summit, and it's already making a difference. It has seen some saves where it's raised the level of awareness, where

that tower controller previously did not have a radar display in their tower, because radar can be cost-prohibitive. We're building some safety logic into our tools, like the Approach Runway Verification that can detect something that the human eye might not be able to discern, where an aircraft is lining up for the wrong runway. A lot of our towers are a mile away from the approach. This tool actually can see that path better than our human eyes. It triggers an alert. The controller is then able to issue direction for that aircraft to go around.

Q: NAV Canada has rolled out a tool that lets managers predict shift needs going forward. The U.K. has Project Bluebird, where they're testing in a safe environment how far they can take AI. Is FAA looking at any of that?

A: AI is what I see in our decision-support tools. As far as shift predictability, we work closely with NAV Canada. The newly appointed CEO of NAV Canada is coming down to meet with me in January at the same time as the head of NATS U.K. I was just at Heathrow Airport at their center in Swanwick, looked at their digital tower. I've been in their learning lab. We have a tech center in Atlantic City that's always testing new technology; what is viable, what's not. We've deployed much of our NextGen. We have sort of the base framework for our modernization effort and new tools developed in collaboration with NATCA [National Air Traffic Controllers Association], our controllers union. As far as shift management, we have several different tools, and we're always asking other countries what they're working on. I sit on an international board with a lot of my peers from around the world. Right now, the greatest area that we see AI helping in is training. You and I were trained by learning things longhand. This generation learns completely differently than we did. Right now, our training pipeline is what I would say is our greatest need. That's where I'm looking for AI and simulation to help the most right now.

Q: The reason I'm asking so much about AI is because we've got a transition of administrations, and I wonder if somebody's going to come in and say, "Dude, you're slow to pick up AI."

A: I would say that if all the aircraft were equipped the same, that would be true, but we don't have everybody using the same type of equipment. That's one of our challenges in maintaining and operating this NAS. There's the legacy National Airspace System, there's the currently modern one, and there's the one of the future —

Q: So this variety of equipment makes it hard to roll out AI tools?

A: Because how do they interact with us? Communications is the biggest challenge. Someone flying in a Piper Cub or Robinson helicopter is just going to pick up the microphone and want to do everything verbally, whereas your modern airliners are exchanging clearances text, DataComm.

Q: Wouldn't it be a no-brainer, though, to have a tool that says, "Dave, are you sure you wanted to direct the aircraft there?" Or maybe there's something like that now.

A: There is something like that now. In the en route world, there is Conflict Probe. It'll detect and say there's a conflict 5 minutes, 10 minutes down the road. In the terminal environment, that's the safety logic of the STARS approach verification system. It does say, "Wrong runway, wrong runway."

STARS is short for Standard Terminal Automation Replacement System, software that contains an "Approach Runway Verification" function, FAA explains on its website. — B.I.

On the ASDE-X, it will issue a loud alert, and the controller will issue the aircraft-to-go around instruction.

Airport Surface Detection Equipment, Model X is a surveillance network created to track aircraft and vehicles on the ground to "reduce critical Category A and B runway incursions," explains FAA — B.I.

Those are all reactive alarms. There are less things that do what you're saying: hearing the instruction the controller is giving and saying, "Are you sure?" There is a very simple piece of technology, Runway Incursion Device, or RID, that we're deploying to 77 airports. As you're trying to transmit an [incorrect] clearance, it's going to repeat over and over to you, "Runway closed, runway closed." It's basically blocking you from clearing someone for takeoff or to land. Not all voice recognition software is working, though, particularly with the speed at which aviation instructions are related. If you've ever listened to an ATC on the radio, there are varying degrees of success on voice recognition. As much as we want to have alerts, we don't want to have the potential downside, and it is a nuisance alert, right? We don't want it saying: "Are you sure?" "Yes, I'm sure. I know what I'm doing; get out of my way." So, yes, I would very much like to proactively preempt a questionable instruction. However, finding the right balance is something we work closely in collaborating with our workforce on testing.

Q: You mentioned training. I saw coming out of the Safety Summit a need for unusual circumstances training. What does that mean?

A: There are airport locations that are normally good weather locations. They don't see fog very often, or snow. We've had runway incursions where the tower controller could not see out of the tower cab and was relying on physical position reports of aircraft in order

▲ **"Beautiful movement of aircraft"**: Planes line up for takeoff last year at Vilnius International Airport in Lithuania.

Karolis Kavolelis via Shutterstock

to give instructions. For one particular airport that had a challenge, we made sure that they got our newest tower simulator capability first, the idea being put them into the simulator to train them on things they don't see very often, whether it is a certain runaway configuration, strong seasonal winds or a heavy volume day. We need to lean into our simulation capability to create those scenarios and train people so that they're not seeing them for the first time in the real world.

Q: About the Department of Government Efficiency that we've probably all heard about, what do you anticipate your interactions with that being? Do you need more efficiency?

A: Two things. One, we are focused on safety, and right behind that, you will always hear efficiency. The Air Traffic Organization and the FAA as a whole are committed to transparency and collaboration. So whether we're working with our workforce, the Hill, industry or the incoming administration, we want to be transparent. We put all of our challenges, all of our demands and expectations on the table and then collaborate toward what the best solution is. We are running the largest, busiest and most complex national airspace system in the world. We're pretty darn efficient, and we run more high-tempo operation airports, in total, than any of my counterparts around the world. Remember, as we're becoming more efficient, we are also trying to integrate drones, commercial space, advanced air mobility. We want to provide equitable access to the airspace. So as we're doing that, we want to be safe at all times, but we need to make sure that we're balancing the needs of everyone looking for that access. We welcome new ideas and the opportunity to show people what we're doing. I think we have a proud story to tell.

Q: Speaking of new ideas, how many schools do you anticipate participating in the Enhanced Air Traffic-Collegiate Training Initiative that lets students bypass the Oklahoma academy?

A: Our team has just reviewed and approved, I think, up to four schools now.

> *Indeed, the schools are Embry-Riddle Aeronautical University, University of North Dakota, University of Oklahoma, and Tulsa Community College. — B.I.*

There are over 25 that are interested. We've constructed this very carefully to make sure they meet all of our criteria to include audio and visual recordings of their graded evaluations so that our regulator can review those evaluations and make sure that they are being tested properly and that they're passing those simulations. All of that meets the same criteria that we have in our academy in Oklahoma. We have schools that are ready to provide graduates for us in the spring semester. They're currently going through their program. It's an initial effort now, but it was important to set up that framework and expand our throughput capability, not to mention resiliency, in that we don't want to have all of our training in one location that also happens to be in Tornado Alley. So we think it'll be the largest growing segment of our future pipeline.

Q: The technology is really interesting, but air traffic controller sounds like a grueling job. Why should a young person want to take that up as a profession?

A: It is not for everyone. It is one of the best-compensated positions in federal government because it is one of the most challenging. This is a great job for anyone who enjoys bringing order from what looks to be chaos. I have that background in public safety; I've always enjoyed helping people and bringing order to a scene. It's the same for an air traffic controller. You're orchestrating this beautiful movement of aircraft and it's perfectly sequenced, and that's because controllers are stepping in and providing timely direction, working closely with their counterparts operating the aircraft. Key is someone with a good short-term memory and the ability to make a decision and move onto the next issue. It is not always the person with a doctorate in mathematics, because if you spend too much time analyzing the problem and not solving the problem, you're not going to be a successful controller. When I was going through the academy over 30 years ago, the psychologists that were meeting with us were trying to figure out who makes the best air controller. Short order cooks and shoe salespeople did very well. Having a pilot background is also beneficial. Being familiar with aviation is beneficial, but you don't have to have an aviation background. Many of our controllers are private pilots, and many are not. I am not. Sometimes it works to your advantage to have an understanding of the system and being able to help pilots. Other times, it's you're not flying the plane; you need to control the sequence of all of the airplanes. The important thing is that we will teach you what you need to know about aviation. It is a unique skill set, but there are plenty of people who enjoy that. And it's not unique to air traffic control. There are people in emergency management, medicine, police work that really are drawn to that kind of work environment, and we're no different. ★

From something old, something new

NASA contractors plan to convert a decades-old cargo turboprop into a hybrid-electric aircraft powered by a combination of fossil fuel and electricity. If all goes as planned, it will be flown for the first time next year. Keith Button learned about the conversion plan.

BY KEITH BUTTON | buttonkeith@gmail.com

Inside a hangar in Moses Lake, Washington, lasers scanned across the surfaces of a 40-year-old De Havilland Dash 7 turboprop dotted with reflective stickers. The plane was immobilized on jack stands, with its wheels retracted and flaps positioned as if in cruise flight. After scanning the entire aircraft, engineers and technicians with AeroTEC, a Seattle aerospace testing and development company, adjusted the flaps and landing gear to the landing and takeoff configurations and then scanned those areas of the plane.

The end result was a digital model of the exterior of the aircraft in multiple configurations. This model is among those that will be needed to meet the June target for completing the design phase of a planned three-year effort to turn this Dash 7 into a hybrid-electric aircraft.

AeroTEC plans to fly the aircraft in 2026 for magniX, the Everett, Washington, electric aircraft motor developer that's the prime contractor for one of the aircraft that are to be flown under NASA's Electrified Powertrain Flight Demonstration project. The goal is to show that the electric motor technology that will be incorporated into the aircraft can reduce fuel consumption by 40% while still permitting the plane to have enough power to carry 50 passengers, although the demonstrator will not do that, given its heritage as a cargo version of the Dash 7. NASA in 2021 awarded magniX a $73.4 million contract for the aircraft conversion and flight tests. The second contractor, Cincinnati-based GE Aerospace, received a $179 million contract to install hybrid-electric internal combustion engines into a 36-passenger Saab 340B.

AeroTEC is a subcontractor for magniX, which is providing the motor, controller, distributor and battery propulsion units for the Dash 7 demonstration. At Moses Lake, AeroTEC engineers must reverse engineer the entire aircraft, meaning not just its exterior but also its structure, electronics and hydraulics, so they know the implications of the changes they must make to turn the aircraft into a hybrid. They must then design and build thousands of parts to accomplish the modifications.

As is typical in the used aircraft market, the Dash 7 didn't come with the original design data or drawings for individual structural components, explains Lee Human, president and CEO of AeroTEC. The engineers knew they would have to build their own computer models of the existing plane before they could figure out how to first replace one the aircraft's four turboprop engines and propellers with an electric motor and propeller, and then after some flights, swap out one of the engines on the other wing with another electric unit. This would require designing new wing structural supports, new nacelle housings for the electric motors, wing modifications for high-voltage wiring and other modifications for the hybrid version. But luckily, the detailed maintenance and structural repair manuals and wiring diagrams that did come with the lease of the aircraft from Canadian operator Air Tindi provided some key information for the reverse engineering.

The engineering, building and testing steps will be the same as those for designing a new plane, though at a lower volume, Human says. The design will go through conceptual, preliminary and critical design and review phases. The modification will also require designing and manufacturing some 3,000 new parts, he says.

There are a few advantages, though, to modifying an old plane for a technology demonstration. For one thing, structural fatigue and maintainability are less of a concern, because the aircraft will be flown for fewer than 1,000 hours compared to the perhaps 50,000 hours a commercial airliner operates.

Another benefit: The hybrid-electric Dash 7 design is not destined for production. "If you're building 100 of something, you really, really care if the material costs an extra thousand dollars or if it weighs an extra 10 kilograms," Human says. "If you're doing it once, you don't really care as much."

So, success is largely about preparation. The laser scanning of the aircraft's surface was done with all fans turned off and doors closed to the hangar space because even sub-millimeter movements of the plane could throw off the accuracy of the scan, Human says.

◀ magniX plans to replace two of the turboprop engines in the Dash 7 at left with electric powertrains for flights under NASA's Electrified Powertrain Demonstration Flight project. The yet-unmodified aircraft is shown at right in its new livery during an August event at King County International Airport in Washington.

NASA/David C. Bowman

Multiple scans taken from different angles marked the X, Y and Z coordinates in space for millions of points on the plane's surface, and the scans were digitally stitched together using the stickers on the plane as landmarks.

Creating the structural model required accessing and scanning the internal structure of the fuselage and wings. This data was essential for the engineers when creating the baseline model they must work from to design and build motor mounts and nacelles for the new electric motors.

"They needed to know in detail every single spar, rib, skin, bracket that's in the aircraft that is physically taking that load," Human says.

For this, some of the innards were viewed by opening access panels and scanning with handheld lasers. That wasn't possible for the interior of the wings, so AeroTEC bought a Dash 7 wing from an airplane boneyard and cut it open. They also bought a Dash 7 nacelle to cut up because they needed a sample of the metal to test, which showed them which aluminum alloy they required for making nacelles for the electric motors.

Once the digital models were created, they removed the reflective stickers from the Dash 7 and flew it 10-15 times in March and April. The flights validated predictions from the models, such as how the plane and its materials would hold up under structural loads.

A concern was that modifying the Dash 7 wings to carry the electric motors — or other structural changes or shifts in weight in the aircraft — might cause flutter, a dangerous phenomenon in which wings or other structures begin oscillating uncontrollably.

"You're changing the modes and the frequencies to which this aircraft vibrates when you change its structure and its mass properties; we're just making sure that is still safe," Human says.

So, they conducted a ground test on the Dash 7 without the new motors and propellers to create a baseline. A hundred accelerometers were attached to the aircraft to measure its response to shaking at a variety of frequencies and directions, with vibration injected into the wings, fuselage, tail and nacelles by about four shakers, either from the ground or mounted on lifts, Human says.

This baseline will be compared to ground flutter tests conducted after the aircraft is modified and before it is flown, he says.

Also, high-altitude flight poses a potential danger for an aircraft propelled in part by high-voltage motors. The thin air provides less of an insulating effect than at sea level, so the magniX engineers had to take that into account in their motor design. Extra insulation was incorporated to make sure electrical discharges would not arc between conductive materials.

In November, magniX concluded tests with a prototype of the motors and other propulsion unit components at the NASA Electric Aircraft Testbed in Sandusky, Ohio. The propulsion unit was set up amid a spiderweb of wires and cables inside a large metal-dome vacuum chamber, designed to simulate environments

▲ For magniX's subcontractor AeroTEC to begin replacing this Dash 7's turboprop engines with a magniX electric motor and powertrain, engineers had to create digital models to determine how to go about the conversion. These models were created by scanning the aircraft with handheld and stationary lasers. The small dots visible on the wing are reflective stickers that served as guides.

AeroTEC

▶ magniX in November concluded simulated altitude tests with a prototype of its magni650 motor, shown here being installed in a vacuum chamber at NASA's Electric Aircraft Testbed facility in Ohio. The chamber replicated the atmospheric and temperature conditions at 30,000 feet.

NASA/Sara Lowthian-Hanna

with as little pressure as outer space, says Ben Loxton, head of magniX's technical programs and testing. The chamber was closed, and a vacuum was pulled to simulate an altitude of 30,000 feet while the unit ran at 700 kilowatts under full power, while magniX engineers watched from a control room. No issues were found.

By the start of 2025, AeroTEC planned to have completed its designs for the nacelle and wing modifications necessary to accommodate an electric propulsion unit, first on the outboard position of one wing, and then after flying, on the other. Plans call for completing the fuselage design by June, the last step in the modification design.

The design work takes that long in large part because many of the necessary batteries, wiring, connectors and other components can't be purchased off the shelf, Human says. "It's not like you can open up an aerospace parts catalog and just pick the stuff. The supply chain in general for these emerging technologies is frankly nonexistent."

Instead, they have to repurpose equipment designed for other industries or, for 80% of the parts, manufacture them.

Once the flights begin with one electric motor, the engineers will incorporate what they learn and then go about replacing the outboard turboprop on the other wing with the second electric unit, Human says.

"We know we're going to learn something when we do this installation and ground testing and flight test. And rather than build two sets of parts and install two engines, let's just do one. There will certainly be some redesign. I don't know what, but that's just why we test," he says.

"If you're building 100 of something, you really, really care if the material costs an extra thousand dollars or if it weighs an extra 10 kilograms. If you're doing it once, you don't really care as much."

— Lee Human, AeroTEC

Overall, though, the team doesn't expect huge technical surprises.

"There is no one thing that's strikingly technically impossible or technically high risk, because we've done electric flight before several times," Human says. "If you just look at it from the simplest form, it's a battery; it's wires; it's an electric motor. While it's new for aviation, this is a technology that's been around for over 100 years." ★

Can Kwaj survive?

The highest point on the Kwajalein island chain, home to the Ronald Reagan Ballistic Missile Defense Test Site, is the cheekily named Mount Olympus. Rising 17.5 meters above the Pacific Ocean, it illustrates a big problem facing the U.S. defense establishment: Arguably its most vital missile, hypersonics and space surveillance venue is uniquely vulnerable to the rising seas of climate change. Is it feasible to keep Kwaj running? We spoke to two U.S. Army colonels whose mission is to make sure the answer is "yes."

BY MIKE GRUSS AND CAT HOFACKER
mikegruss@gmail.com and catherineh@aiaa.org

The waves knocked down doors, upended furniture and tipped over bookshelves, leaving flooding in their wake and an unspoken question: Is this the future?

The scene was January 2024 on the island of Roi-Namur, the second largest among the 100 slivers of land that form Kwajalein Atoll in the Pacific Ocean, an oblong ring of islands north of the equator. About 120 U.S. military personnel and contractors live and work on Roi-Namur to run its radars and telescopes. This island is about a quarter the size of Key West, Florida, and is home to the majority of surveillance equipment within the Ronald Reagan Ballistic Missile Defense Test Site, which comprises 1.9 million square kilometers of ocean and multiple missile launch sites on various islands.

"Kwaj," as military people call the atoll and the surrounding test range, is a focal point for U.S. missile defense testing and the surge of hypersonic weapon experiments that the U.S. has embarked on to try to catch up to China on the technology.

"Because it is so wide open, it allows us to test without having the fear or the risk of causing any damage to personal property, infrastructure, personal land or any injury to people," says Army Col. Juan Santiago, who directs the Reagan Test Site from Redstone Arsenal in Huntsville, Alabama.

Also, the atoll's position near the equator puts its telescopes and radars in the closest possible proximity to satellites positioned high over the equator in the geo-belt. In particular, U.S. officials view the Millimeter Wave Radar on Roi-Namur as one of the finest-resolution imaging radars in the world, perfect for "space object identification," according to a 2012 article in the journal of the MIT Lincoln Laboratory. The atoll is also well-positioned for getting an early look at Chinese missile and weapon tests over the Pacific.

The trade-off is the watery surroundings 7,000 km from Australia and 8,000 km from the continental U.S. Kwaj is literally in the middle of the Pacific Ocean.

"This is like the space station. It's remote and isolated, and resupply is not frequent and not assured," says Army Col. Andrew Morgan.

As a NASA astronaut who spent nine months on the International Space Station in 2019 and 2020, he should know. Morgan is now commander of U.S. Army Garrison-Kwajalein Atoll on Kwajalein Island, the atoll's largest island, about 80 km from Roi-Namur and half as big as Key West. Kwajalein Island is less desolate than Roi-Namur. Nearly 1,400 personnel are stationed there, including their spouses and children who attend the one school with two campuses for various ages.

An assignment to either island is a unique experience. "Under any circumstances, it's a difficult place to work and operate because of its remoteness and its austerity but also the environmental conditions that it's located in," Morgan says.

The flooding of Roi-Namur underscored what scientists have contended for years: that such events are indeed the future for low-lying places such as Kwajalein as seas continue to rise due to climate change. Roi-Namur's average elevation is 2 m, and the atoll's highest point, Mount Olympus, is a 17.5-m-tall artificial hill with a rocket launch pad on top.

The climate threat to Roi-Namur and the rest of the Reagan Test Site has arrived just as China is making inroads in space and on hypersonic weaponry, and

▲ Continued sea level rise could disrupt future operations on Kwajalein Atoll, including the tracking of hypersonic vehicles and ballistic missiles. Here, a Minuteman III intercontinental ballistic missile launched from California streaks over Kwajalein in November, in a test conducted by the Air Force's Global Strike Command.

U.S. Army

the atoll's facilities may be needed most by the U.S.

On Roi-Namur, seawater poured through the bachelor quarters, rendering air conditioning units worthless, disrupting power distribution and wreaking havoc on the dining facility. The Army promptly evacuated 80 of the 120 people who live on the island and began "Operation Roi Recovery," a months-long cleanup effort.

The proximate cause of this damage? A cyclone that formed days earlier near Japan and moved eastward. The sea under the storm rose to meet the lower pressure above, where powerful counterclockwise winds whipped up waves that radiated outward and settled into rolling swells. The storm came no closer than several hundred kilometers to Kwajalein, but shortly after the sun set last Jan. 20, the swells met the shallows on the north side of Roi-Namur, morphing into 4.5-m-tall waves that crashed into the northernmost point of the atoll for about half an hour.

Storm-driven waves are of course an entirely natural phenomenon. But from 1990 to 2020, the seas around the atoll rose 11 centimeters, as measured by Europe's altimeter-equipped Sentinel satellites. This, says coastal scientist Curt Storlazzi, made the damage worse, and is just the start of what faces the atoll in the years ahead. Up to 20 cm of additional sea level rise is forecasted by the United Nations' World Meteorological Organization through 2050.

When that happens, it won't take a cyclone as strong as last year's to do lots of damage. "Now, a smaller wave with shorter periods can run as far inland as a much bigger storm with bigger waves and longer periods did when sea level was lower," explains Storlazzi, of the U.S. Geological Survey. He has analyzed flooding of the atoll going back to 2008.

And so, the clock to reimagine the islands' infrastructure is ticking. A 2017 study led by Storlazzi predicted that seawater would soak into Kwaj's already brackish groundwater, making it too salty for the existing water treatment plant to render it drinkable through reverse osmosis. The saltwater intrusion will mean no potable water by 2035, Storlazzi and his teammates predicted in a report for the Defense Department, "The Impact of Sea-Level Rise and Climate Change on Department of Defense Installations on Atolls in the Pacific Ocean."

Morgan, the garrison commander, has an idea. "It's a highly humid environment, so there's a lot of water stored in the air, and we can collect that," he says. He's referring to water reclamation, in which water is extracted from the ambient air to produce potable water.

In addition, DARPA has funded research through its Atmospheric Water Extraction program to develop small, lightweight, low-powered, distributable systems for the daily needs of roughly 150 people. The roughly

History-making venue

SpaceX's unprecedented launch rate, modern anti-missile defense technology and U.S. progress on hypersonic weapons all share something in common: Key tests or launches occurred at Kwajalein Atoll in the Pacific Ocean.

1962 A Nike-Zeus missile launched from Mount Olympus on Kwajalein Island detonates within 2 kilometers of an ICBM target, close enough to count as the design's first ICBM interception.

1963 A Nike-Zeus missile intercepts an Agena D rocket stage, demonstrating the first U.S. anti-satellite capability.

1968 The first developmental Spartan anti-ballistic missile interceptor is launched from Mount Olympus on Kwajalein Island.

1984 A Homing Overlay Experiment interceptor launched from Meck Island destroys a dummy warhead, the first "hit-to-kill" interception by a U.S. ballistic missile.

2006 Under DARPA sponsorship, SpaceX attempts to launch its first Falcon 1 from Omelek Island on the eastern side of the atoll. The first-stage engine shuts down after liftoff, and the rocket crashes into the reef. Three years later, a Falcon 1 sends RazakSAT, a Malaysian Earth-observation satellite, to orbit, marking SpaceX's first successful customer launch.

2024 A B-52H Stratofortress takes off from Guam with a prototype of the Air Force's Air-launched Rapid Response weapon for the design's final flight. The missile is fired at an undisclosed location near Kwajalein, the first U.S. test of a hypersonic cruise weapon in the Pacific.

▲ Most of the U.S. personnel on Kwajalein Atoll live on Kwajalein Island, the point of land at the bottom right of this satellite image taken by a Landsat spacecraft in 2014. The majority of the radars and other equipment for the Reagan Test Site are located on Roi-Namur (inset), the atoll's northernmost point.

NASA/USGS and U.S. Army/Jason Cutshaw

1,400 people on Roi-Namur and Kwajalein Island consume 20 million liters of water a month, according to Army budget documents.

An ever bigger issue lurks, however. By the most optimistic calculations, in 85 years Kwajalein's islands will flood so regularly that operations there would be impossible. There will be some mitigating effects from the changing climate, namely slightly lower wave heights on average in deep waters, slower wind speeds and less frequent typhoons. But these "will likely be insignificant in comparison to the impact of projected increases in sea level in the region."

Take a scenario in which the sea level rises 40 cm. In that case, at least half of Roi-Namur would be flooded by the distant effects of a storm like the one last January. And during these floods, more infragravity waves could hit the shoreline. These irregularly shaped waves formed by the wind can rise to several meters and exacerbate flooding. In addition, warmer water means more coral bleaching events, in which the individual coral polyps expel the algae that nourish their cells and gives them their color. This means smoother reefs that allow more run-up and flooding from waves.

It's challenging, but Morgan and Santiago aren't in their roles to give up on Kwajalein. The atoll is "an ideal place to demonstrate climate resilience," Morgan says. He has a message for senior Pentagon and service

FACT

BLOODY HISTORY: The United States seized Kwajalein Atoll from Japanese forces in 1944 in fighting under Operation Flintlock, the U.S. invasion of the Marshall Islands in World War II. Today, the U.S. retains security responsibility for the atoll and the rest of the Marshall Islands under a financial agreement with the Republic of the Marshall Islands. The compact gives the U.S. unlimited access to its land and waters "for strategic purposes," as the U.S. Department of the Interior explains.

leaders who visit: "Let's make this the Epcot Center for Climate Resilience, for the Army, for the Pacific, for the DoD."

Among the possibilities: studying new paints and coatings that could be applied over existing paints on radar components to reduce rusting. Morgan says Kwajalein is well-known for its "highly corrosive sea spray that devours any sorts of metal and even plastics after a time." Unlike a Navy cruiser, Kwajalein can't be taken into dry dock for a season and reemerge sparkling.

Another option would be to modernize the radars. "We can go from analog to more digital, more of a digital footprint," explains Santiago. "And so what that'll help us do is reduce the components and parts that we have to keep on hand that, again, are also challenging, because you have to maintain those in a climate-controlled environment so that those spare parts don't rust."

Also, where applicable, structures could be rebuilt away from the most flood-prone areas and made so they stand a meter or so higher than the projected sea level rise. Already, housing on Roi-Namur is located on higher ground than other parts. (Storlazzi's 2017 report notes how cameras installed there as part of another study stopped working because water ruined the batteries.)

The Army's fiscal 2025 budget request and five-year spending plan proposes spending roughly $2.2 billion to operate the Reagan Test Site during that period. That includes at least $1.2 million in fiscal 2025 for research on mitigating climate risk.

The first half of 2024, though, was a race to get Kwajalein back in shape. As many as 10 launches of ballistic missiles or hypersonic weapons occur from the atoll each year. A test of unarmed intercontinental ballistic missiles in February had to be rescheduled, but in June, the team on site conducted three tests. U.S. leaders refer to Kwajalein as the premier place to test hypersonic weapons.

On Roi-Namur: "We haven't been able to get back to rebuilding the chapel or rebuilding the outdoor theater, because those just have not been priorities relative to getting bachelor quarters and dining facilities and radar systems and runways up and running," Morgan says. "Any time you flood a building, of course, that means that you're going to have to gut it."

He adds: "Overall, it's a little bit of a quality-of-life setback. Certainly, the sense around here is that it's going to be a long time before we ever get back to even where we were, let alone better than where we were."

But looking long-term, he is upbeat, despite the warning shot and predictions of further sea level rise.

"Kwajalein's best days are still ahead of us," Morgan says. "Our leaders recognize Kwajalein is important and it was in a fragile state, and that we're going to need to reinvest in it heavily to get it back recovered and need help to achieve its full potential over the next decade or two. Because it's important now — it's more important now than it has been in many decades." ★

▲ The U.S. Army spent much of 2024 repairing the damage to Roi-Namur last January. The island is the second largest on Kwajalein Atoll and home to 120 personnel, 80 of whom were evacuated to Kwajalein Island after the flooding.

U.S. Army/Jessica Dambruch

THE BIG QUESTION

Will humans ever permanently settle on Mars?

With President-elect Donald Trump and Elon Musk palling around at Musk's Starbase in Texas and Mar-a-Lago after the election, it's reasonable to wonder if U.S. tax dollars are about to be directed toward Musk's goal of establishing a permanent human settlement on Mars. NASA has long voiced a desire to send astronauts to explore Mars (the latest target being sometime in the 2040s), but it does not yet have a firm plan to do that, and it has never embraced human settlement as a goal. For example, the Crew Health and Performance Exploration Analog, or CHAPEA, missions it is funding are meant to simulate "year-long stays." Is a permanent presence possible? Here's what six space community leaders have to say.

BY DEBRA WERNER | **dlpwerner@gmail.com**

Kelly Haston

Commanded NASA's first Crew Health and Performance Exploration Analog, or CHAPEA, mission at NASA's Johnson Space Center in Texas.

YES NO MAYBE

Humans will eventually have a permanent presence on Mars because of our spirit of exploration and the opportunity to learn on the first habitable planet other than our own. And it's a relatively close opportunity to hone the space exploration skills we will have developed on the moon. How big that presence becomes is a function of questions that we can't answer yet: What is our space travel capability by the time we settle on Mars? Can we go farther? Is it going to be a way station to more distant destinations?

I can't put a timeline on Mars settlement, but I do think it's going to be many years. The logistics of the inaugural mission under CHAPEA, a multidisciplinary, collaborative project, were very complicated. Even putting something on Earth to look at a subset of factors important for Mars exploration was complicated. That being said, new technologies may accelerate it: improvements in rockets, communications, food production and what we learn from the moon.

"My hope, as a scientist and as a human being, is that we can be very thoughtful and intentional with our approach to going to Mars."

— Kelly Haston

The overall CHAPEA project is looking at the impact of different challenges people will face in extreme environments, like Mars. In my analog, we had Mars-realistic communication delays. When we were the farthest from the Earth, it was over 22 minutes one way, meaning at least 45 minutes to get information or answers. The crew worked out unique ways to deal with that for communicating with the NASA ground crew and in our personal communications. We did not speak to anyone else face-to-face for over a year, so we relied on each other a lot!

We also tested food growing and production systems. While some food will be brought to Mars, we will have to figure out how to produce some food on Mars to keep people healthy when under the physical challenges of another planet. While we did not have the radiation and gravity challenges in my analog mission, we were under stress due to isolation, resource restrictions and the communication delay.

It was a very positive experience overall. It wasn't always easy, but I want to commend NASA for the support that they gave us. I'm very proud that the crew managed to be productive and cohesive for the whole mission.

My hope, as a scientist and as a human being, is that we can be very thoughtful and intentional with our approach to going to Mars. What do we bring to the surface when we go to planets or the moon, and what will we leave behind, such as waste products, garbage or even our own natural bacteria? How will that impact that environment? Also, in all cases, the best way to do science is collaboratively. How are we going to deal with each other in space or on Mars?

Nick Kanas

Co-author of "Space Psychology and Psychiatry," among other works, and emeritus professor of psychiatry at the University of California, San Francisco.

YES NO MAYBE

In addition to engineering and physiological challenges, Mars has special psychosocial stressors. There's the allostatic stress of long-term low gravity and radiation. Whatever that does to your body is going to affect your emotional state. You're going to have extensive isolation and monotony. You're going to be with the same group of people for the two to two and a half years of the first Mars mission. You'll be dependent upon yourself because of the time delay in communication. That's different from the International Space Station, where lots of the activities are done with planning and in cooperation with mission control. Also, there's the Earth-out-of-view phenomenon that I've written about with my colleague, Dr. Dietrich Manzey. Humans have never experienced seeing the Earth as an insignificant dot in the heavens. That might enhance the sense of isolation and lead to depression or homesickness.

Looking at Earth colonization, people have described different phases. For colonies in the Pacific, there was a pioneering phase. Then a consolidation phase, where you set up norms of how to govern yourself. Finally, as things become secure in terms of growing food and survival, the colony stabilizes and starts to become an entity. That might occur in a Mars colony, but then you have the distance. Earth will have an impact on any Mars colonies, but perhaps less than on a lunar colony, where you'd be three days away. A Mars colony would start developing a sense of independence and autonomy sooner than a lunar colony. Resupplying from Earth will be slow, so a lot of oxygen and fuel will have to be generated on Mars from local resources. The crew will be fairly autonomous from the get-go. After a while, the colony may want to break away from Earth or form its own nation.

Presumably, colonists will have some way to go back to Earth. Nevertheless, it's going to be a long six-, seven-month journey. For all intents and purposes, they will be based on Mars and have to get along. The governance structure may vary. They will probably have a semi-military command structure. In time, it may become more democratic as the colonists see themselves as a separate entity. They might have different family structures, depending on the ratio of men and women. If children are born, if they can survive the lower gravity of Mars, they might have a communal setup that reflects the situation of being so far away from home. The social structure could vary according to what the psychological climate is like in the new colony.

"Humans have never experienced seeing the Earth as an insignificant dot in the heavens. That might enhance the sense of isolation and lead to depression or homesickness."

— Nick Kanas

Dava Newman

A former NASA deputy administrator and now Apollo Program professor of astronautics at MIT and director of its research-focused Media Lab. AIAA fellow.

● YES ○ NO ○ MAYBE

I'm not sure I'll see it my lifetime, but I work on making this a reality every day. The first human explorers on Mars will have a scientific mandate: the search for life. It's a roughly eight-month trip in an isolated, confined environment, so my preference is that they stay on the surface as long as possible to find possible evidence of life, past or present. Then, it's a year-and-a-half return trip. It's not ethical for it to be a one-way trip if it's funded publicly.

That is the first phase of humans on Mars; there could be a second phase and a third phase. Can we live off the land? Have settlements or towns or communities? I don't have illusions that we'll have millions of people in large cities. We'll have explorers. Antarctica and some places in the Arctic may be our best analogs, and they are infinitely more hospitable than Mars.

We should be cautious and have humility in the beginning. We have a lot to learn and it's risky. People are going to die. We need to communicate the high risk of exploration missions. What's going to kill our astronauts? The main potential showstoppers are radiation, the psychosocial aspect and musculoskeletal deconditioning, or an unforeseen mission catastrophe.

Physiologically speaking, radiation is No. 1. We've been exploring on Mars for the past 50 years with orbiters, landers, rovers and a helicopter. We know quite a bit about the radiation environment. Our research provides solutions to protect humans during EVAs, in habitats and laboratories.

Then there's the psychosocial aspect. Mars is beautiful, red and dusty. But when Earth is just a little speck, that's going to be interesting. Human factors, coping and teamwork will be paramount. Most of our experience in this area comes from analogs and expeditions in submarines, Antarctic and Arctic exploration. When it goes right, it's great. But when it goes wrong, sometimes it goes terribly wrong.

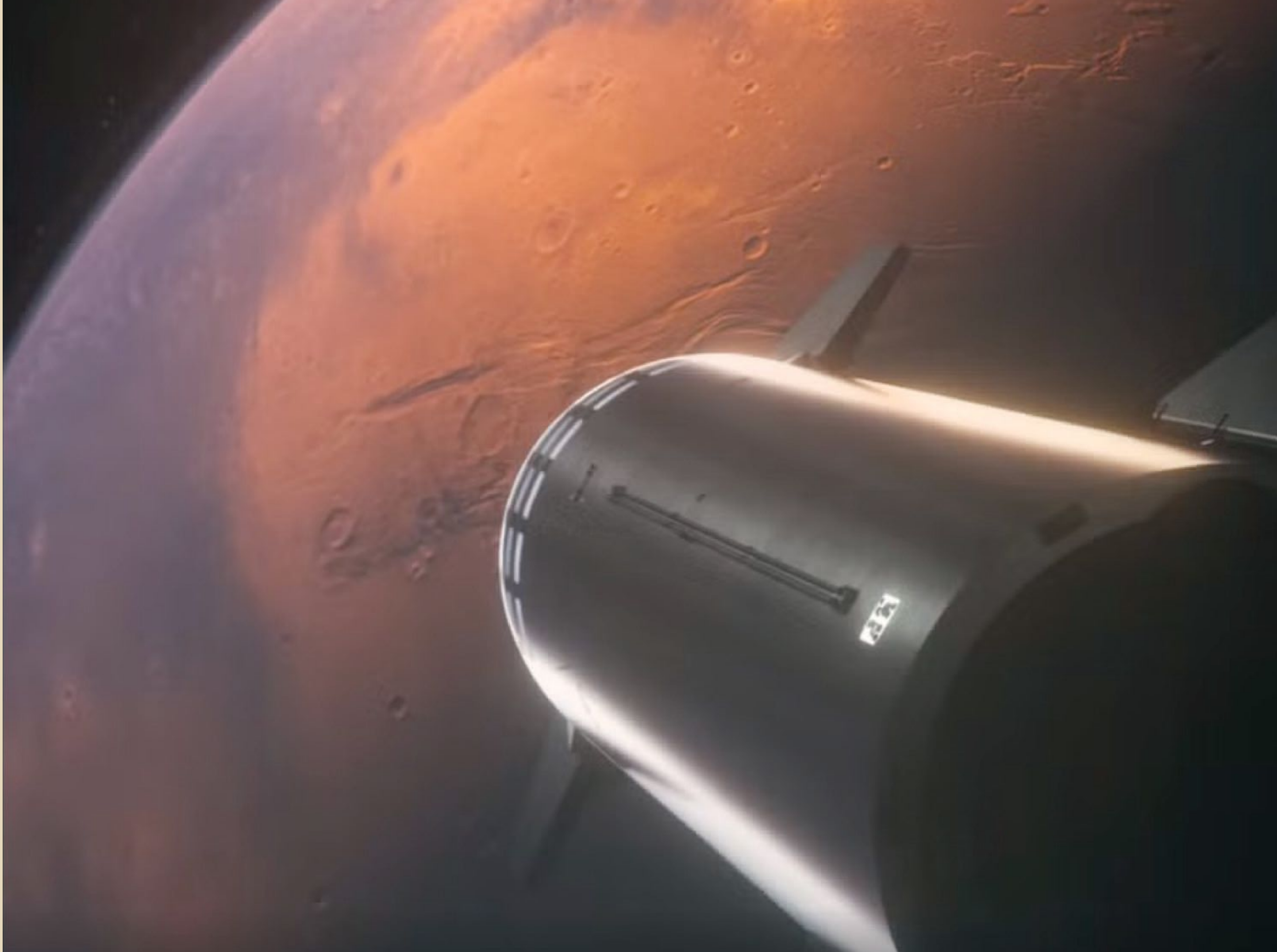
"I don't have illusions that we'll have millions of people in large cities. We'll have explorers."

— Dava Newman

One of my specialties is investigating musculoskeletal deconditioning. We're measuring 1-2% bone mineral density loss per month on the International Space Station. That is with hours of exercise every day. Mars gravity is three-eighths of Earth's gravity. We can all slam dunk a basketball — one of my life dreams! People are going to be able to work well in it, but it's still low gravity. How we prepare for, monitor, address and try to prevent the bone loss will be a major issue.

Moon settlements will give us the needed technology push and experiential learning. We need a spacesuit, life support systems, habitats, rovers, robots. And heavy-lift launch capability, which is coming right along, will facilitate more people going.

CONTINUED ON PAGE 32



Elon Musk wants to launch the first uncrewed Starships toward Mars in 2026, the next time the orbits of Earth and Mars align, reducing the transit time to as little as six months. "If those landings go well, then the first crewed flights to Mars will be in 4 years," Musk wrote on X in September. "Flight rate will grow exponentially from there, with the goal of building a self-sustaining city in about 20 years."

SpaceX

Jeff Thornburg

Former chief architect of SpaceX's Raptor engines and now CEO of Portal Space Systems, a Washington satellite startup.

● YES ○ NO ○ MAYBE

It's a matter of when. When I was working at SpaceX and on Raptor and the beginnings of Starship, I thought about it a lot. We can do a flags-and-footprints mission in the next five to 10 years, and we should because we need to better understand the environmental factors. Recent Mars probes have measured radiation. Are there caves for settlements? There is water on Mars for drinking and to create propellant and other things, but it might be upwards of 10 or 20 kilometers deep in rock. We may have to bring mining equipment to get to the water.

The moon is a great first step. You're only a few days away from getting help if trouble ensues, and it will, because humans make mistakes. On Mars, you're somewhere between six and 24 months from getting help, depending on where the planets are. We're going to have to shorten the time frame to get there. With today's tech, a trip is at least nine months each way. How many humans are going to sign up for a nine- to 12-month journey with no certainty that they're going to survive? Then, they're going to have to stay either a very brief time or a very long time. It would be a shame to only be on the surface for two weeks before you spend another nine months coming home.

> "We could have an Antarctic-style research station in the next decade or two, but colonization implies a self-sustaining entity."
>
> — Jeff Thornburg

We could have an Antarctic-style research station in the next decade or two, but colonization implies a self-sustaining entity. The Antarctic research stations require constant resupply when the weather and seasons allow.

We've got a lot of work to do. New space companies and engineers, in general, tend to look at the tech. That's the fun part, but you've got to bring in doctors and psychologists and people outside of space tech to figure out how we keep people alive and thriving in a very austere environment.

You probably need to pre-position a lot of assets. We're a few years away from being able to do that. SpaceX has targeted this huge payload capability for Starship to pre-position assets there. Then if there's trouble, people have spacecraft to get home. But you also need the ability to autonomously make propellant for the return trip. That's possible thanks to the carbon dioxide and water. Let's demonstrate we have access to water, because that's going to be key to getting people there and back. A one-way trip is going to appeal to a very limited set of the population, unless there's some sort of catastrophe on Earth.

Kelly Weinersmith

Adjunct biosciences professor at Rice University and co-author of "A City on Mars: Can We Settle Space, Should We Settle Space, and Have We Really Thought This Through?"

○ YES ○ NO ● MAYBE

Elon Musk is saying that in the next 30 years, we'll have a million people living on the Martian surface. I don't think that is going to happen. When most people talk about settlement, they mean families having children who grow up to have their own children. The goal, ultimately, is to have settlements become self-sustaining, which means they make everything they need from resources found on Mars.

There are big problems that we still need to solve. We need to figure out how to protect human bodies from space radiation. Most proposals involve piling meters of regolith over a habitat. I don't think that's what most of us imagine when we think about living on the Martian surface. We imagine geodesic domes, red skylines and seeing the sun rise on a foreign planet, not living underground like a mole. We don't know if 40% gravity is enough for bones and muscles to develop appropriately. We don't know if we can have babies on Mars yet.

The International Space Station is regularly resupplied with food and equipment. Round trips to Mars are two to three years long. It makes sense to go to the moon first to test habitats we're planning on using for Mars settlements, and it would be great to have a human living on the lunar surface for three years. That would be longer than anyone has been in space consecutively. They'd be exposed to one-sixth Earth's gravity and exposed to space radiation. If the shielding works, we can port it over to Mars.

Most of the funding for Mars settlements is coming from SpaceX. If we're serious about settlement, we need to do research on human reproduction. We need systems that recycle everything like Biosphere 2 in the 1990s or China's Lunar Palace, which recycled water and grew 78% of the food by mass. Mealworms were the protein source because they could eat the parts of the plants that the people couldn't eat. Lunar

Palace had three people living in the facility. The carbon dioxide levels went up and down wildly until two big guys were switched with two smaller women. Having these sorts of recycling systems running on Mars is not going to happen in 30 years.

> "If this becomes the next Cold War or a new space race, more money could get thrown at the problem and settlements could scale up quickly. But the self-sustaining part is hard to imagine."
>
> **— Kelly Weinersmith**

Over many generations, Mars settlements could happen. If this becomes the next Cold War or a new space race, more money could get thrown at the problem and settlements could scale up quickly. But the self-sustaining part is hard to imagine. Computer chips are small and light. It's easier to imagine filling a rocket ship with them than telling Martian settlers to build their own computer chip factory.

Robert Zubrin

Founder and president of the Mars Society in Colorado. Created the Mars Direct mission architecture while working at Martin Marietta in the 1990s.

● YES ○ NO ○ MAYBE

I believe that Starship is going to be successful. It is a fully reusable heavy-lift vehicle with an operational concept of being able to be refueled in low-Earth orbit and sent to Mars. If Starship is successful, it will be copied.

Elon Musk is pushing for a humans-to-Mars program now. He has the ear of Trump. That will lead to exploration. Through exploration, we'll learn how to operate on Mars and create a scientific base.

How do we get from there to settlement? A key factor will be used launch vehicles. Musk told me at one time that he thought he could build the Starship upper stage for $10 million, which means that either he or a copycat will, at some point, be willing to sell them for $20 million. Someday, they will be available used for $2 million. If one of these can transport 100 people to Mars, that's $20,000 a person. That is a cost that a person of moderate means could afford if they want to pull up stakes and go to a new world.

There will always be groups of people who want to be able to go somewhere where they can cut their own path. Once that is technically possible, there will be settlements.

> "There will always be groups of people who want to be able to go somewhere where they can cut their own path. Once that is technically possible, there will be settlements."
>
> **— Robert Zubrin**

We could get our first human expedition on Mars within 10 years. That will require surface systems, spacesuits, vehicles, life support systems and power systems. The Musk mission architecture is a variant of my Mars Direct architecture, which requires return from Mars with propellant made on the Martian surface, methane-oxygen fuel made out of water and carbon dioxide, both of which are clearly available on Mars. But it takes power. Musk's plan would require a 600-kilowatt nuclear reactor, which would probably need to be developed by the government because it involves controlled materials. That is why this program needs to be a public-private partnership.

If this is perceived as a hobby horse of a very partisan group, it stands a high chance of being canceled when political fortunes change. If they can make this a national program, rather than a Trump program, we can have a substantial permanent Mars base 10 years after the first expedition: in the 2040s-2050s.

I do not believe that Mars will be settled by fleets of 1,000 Starships every two years with 100,000 people. It's going to be much more like the settlement of America with relatively small groups starting settlements. The settlements will establish greenhouses to grow food and various industries to turn Martian iron oxide into steel, create plastics and other materials. The agricultural-industrial base will allow the population to increase. ★

Permission to launch

The U.S. space industry wants regulatory changes that would speed up the licensing of launch and reentry, as FAA delays mount. With Elon Musk's new government advisory role possibly spelling a monumental shakeup, Jonathan O'Callaghan investigates why licensing takes so long and the possible solutions.

BY JONATHAN O'CALLAGHAN | jonathan.d.ocallaghan@gmail.com


APPROVED
APPROVED

For almost six months, a spacecraft operated by Varda Space Industries of California was stuck in orbit. Their washing-machine-sized uncrewed capsule, Winnebago-1, was launched in June 2023 on a mission to make a form of the drug ritonavir, used to treat HIV/AIDS. The crystalline drug and control samples would be returned in the capsule under a parachute, hopefully demonstrating that a drug created in space could be brought home without its chemical structure being ruined.

Varda needed permission from FAA to attempt the reentry. Months into the mission, it had still not received its license.

"There was no law or regulation that said you can't launch without your reentry license," says William Bruey, Varda's CEO. The company chose to launch the spacecraft without a license in the belief that it would arrive in good time. Initially targeting a reentry in September 2023, Winnebago-1 remained stranded until Feb. 14, 2024, when the license arrived. One week later, it touched down in the Utah desert. Analysis showed that the drug's structure indeed remained stable.

Prompted in part by this saga, FAA two months later posted a notice in the U.S. Federal Register that, going forward, reentry vehicles must have a reentry license before they are launched.

The situation highlights current complaints with FAA's lengthy launch and reentry licensing process. "The regulations are 100% throttling humanity's expansion into the cosmos," says Bruey. "It took us two and a half years to build a spacecraft that got into space, and almost as long to get the license."

Some in the industry view the oversight as heavy handed, and they fear it could quell innovation. Of particular concern is China.

"The only things holding the Chinese back are math and physics," says Dave Cavossa, president of the Commercial Space Federation in Washington, D.C. "Our leadership in space is at risk. The Chinese government doesn't take this long to license launches."

At least one congressional ally has taken note. "Inefficiencies in our launch licensing process cause me great concern," U.S. Rep. Brian Babin (R-Texas) said at a subcommittee hearing of the House Committee on Science, Space, and Technology in September, which I watched online. He added that applications were "taking years to complete" and that many licenses were "still under review, impacting launch schedules and NASA missions."

SpaceX and its CEO, Elon Musk, have been particularly vocal about the effect that regulatory delays are having on the rapid development of its Starship-Super Heavy combination. In a statement posted on

▲ Water rushed through the flame deflector at SpaceX's Starbase launch pad in a test of cooling technology that protects the concrete pad from the flames of Super Heavy ignition. Installation of this water deluge system was one of the "corrective actions" approved by FAA after the inaugural Starship-Super Heavy launch spewed pulverized concrete into residential areas.

SpaceX

its website in September, SpaceX called some of the issues raised in FAA's licensing process "patently absurd." The same day, Musk made this post on the social media site X: "We will never get humanity to Mars if this continues."

Others point to a need for the government to be vigilant about safety and mindful of impacts on the environment as Musk and others expand our economy and perhaps society into space.

"It's a delicate balance," says Michelle Hanlon, executive director of the Center for Air and Space Law at the University of Mississippi's School of Law. She sees complex factors at play, particularly for Starship, the effects of which on the local environment are still being studied. With SpaceX and others pushing for faster regulation, and environmental groups raising the alarm, the situation could be at a tipping point — one that might be influenced by Musk's advisory role to the incoming Trump administration to help improve government inefficiency.

The biggest challenge facing FAA right now is the rapid increase in space activities, says Wayne Monteith, who led the Office of Commercial Space Transportation from 2019 to 2022.

"The launch cadence has got significantly greater, and there's a diversity of launch vehicles that all have to be licensed," he says. "And now there's an increase in requests for reentry licenses too. FAA has not been able to keep pace with the increased demand."

▲ Varda Space Industries' Winnebago-1 capsule orbited for nearly six months longer than planned, as the company waited to receive its reentry license from FAA. The capsule touched down in Utah in February.

Varda Space Industries/John Kraus

How FAA came to be responsible for regulating launch and reentry dates back decades. In 1982, Deke Slayton, one of NASA's Mercury Seven astronauts, started the company Space Services Ltd. to launch rockets.

"They started checking who they needed to talk to to get permission," says George Nield, who was head of the Office of Commercial Space Transportation from 2008 to 2018, "and it turned out there were like 16 different agencies that each wanted to weigh in."

To take over those functions, in 1984, President Ronald Reagan and Congress established the Office of Commercial Space Transportation, known as AST for its designation within the Department of Transportation office code. In 1995, the office was moved into FAA.

"It's been that way ever since," says Nield.

For years, that process was adequate because rocket launches were few and far between. In 1995, for example, there were a little over 20 successful orbital launches in the U.S. That has all changed in 15 years, and for one main reason.

"Let's just say it out loud: SpaceX," says Hanlon. The company has transformed U.S. launch with its partially reusable Falcon rockets and, soon, Starships. When I completed this article in mid-December, 127 Falcon 9 launches had been conducted in 2024, an

▲ President-elect Donald Trump and Donald Trump Jr. traveled to SpaceX's Texas facility in November to watch a Starship-Super Heavy launch with Elon Musk.

Brandon Bell/AP

average of two a week, and other companies are hoping to follow suit.

"It's not just SpaceX," says Hanlon. "Blue Origin, Rocket Lab — this reliance on space assets is just going to grow. Our civilization is just going to need it more and more."

Many of these companies have lofty ambitions. Blue Origin is aiming for a launch every two weeks by 2026, Rocket Lab a launch a week and SpaceX eventually three Starship launches per day, Musk said in 2022 at the company's Starbase launch site in Boca Chica, Texas.

FAA's regulatory framework, once tasked with overseeing just a couple dozen launches a year, now faces a revitalized industry. In an attempt to deal with this new reality, FAA introduced a new regulatory framework in 2021, Part 450, that was to meant to streamline the licensing process. [See "What is Part 450?" on facing page.] But the implementation has gone "not well," says Monteith, with some applications taking years to complete.

"There's still ambiguity in what it takes to meet the requirements," he says. FAA declined to make someone available for an interview but responded to questions via email, saying it "strives to make license determinations in a shorter amount of time."

The agency was given little time to implement this sweeping licensing change after being directed to do so by the first Trump administration's Space Policy Directive-2 in 2018, says Monteith, who led the Office of Commercial Space Transportation during the transition to Part 450.

"The review process was truncated significantly," he says. "We were not able to collaborate with industry as much as would have been beneficial."

The end result? Regulations that solve some issues but hamper others. FAA can now license launches in batches, meaning that multiple Starship flights, for example, can be approved without having to individually license each one.

"The idea is you're creating a class of rockets," says Paul Stimers, an attorney and lead of the space policy team at the Holland & Knight law firm in Washington, D.C. That begins to align space launch more closely with aviation, in which the design of a passenger jet is approved for flight but each aircraft doesn't need a license for takeoff.

"There's no other vehicle that we regulate by the ride," says Stimers. "It really doesn't make sense for us to continue to do it with rockets."

The licensing process can still be painstakingly slow. FAA has 180 days to respond to an application, but the initial discourse that takes place between the agency and a company via email, phone and in person before the application is submitted must also be considered.

"That is what is starting to take most of the time," says Stimers.

That being said, not everyone thinks the licensing rules need a grand overhaul. Justin Fiaschetti, CEO of the California reentry company Inversion, which received a reentry license to return a capsule under Part 450 in October, says he found the whole process straightforward. "We started the process about 18

What is Part 450?

Part 450 is FAA's attempt to streamline how it regulates launch and reentry vehicles. Prior to its introduction in 2021, the licensing process was addressed under several different policies within FAA. "It changed everything," says Brian Weeden, who leads the policy and regulatory team at the Secure World Foundation in Washington, D.C.

Weeden gives an example of getting a license to launch from multiple locations. "Before this reform, you would need two different licenses," he says. "Now, you don't need to do that."

The reform also switched FAA from licensing launches on a prescriptive basis — that is, telling companies how they should achieve launch and reentry — and moving to a performance-based approach. "The regulations describe what the goal is, and how to meet that goal is left up to the licensee," says Weeden. "That was something requested by industry."

"It changed everything."

However, Part 450 is a long policy — 700-plus pages as a PDF — with many topics to be addressed by companies applying for a license. That can take time, years for some applicants, while modifications to existing licenses can also take months or more.

At the end of the process, including back and forth with FAA to address any queries (sometimes merely by email or phone), a company will get its license if it has satisfied all the requests. That final license can be short, but still grueling to obtain.

"Ours was seven pages," says William Bruey, CEO of Varda Space Industries. "It's up on the refrigerator." — *Jonathan O'Callaghan*

months prior," he says, with plenty of time for the development of their spacecraft. "It was a pretty smooth process. We didn't run into any substantial hurdles."

Inversion ultimately wants to have vehicles reentering the atmosphere multiple times per day. "There's nothing stopping that right now,"Flaschetti says. "From our perspective, as long as you have the experience and foresight to know you're going to need regulatory approval, it's pretty straightforward."

While bemoaned by some, FAA's regulations exist for a reason, says Billy Nolen, who was FAA's acting administrator from 2022 to 2023. "It is first and foremost about safety," he says, including "the safety of people on the ground, environmental protections and debris fields."

Nolen didn't reference any specific companies, but for others, Starship leaps to mind. We "don't know what the impact is" of Starship on the surrounding environment yet, says Eric Roesch, a U.S.-based environmental compliance and policy expert.

Each rocket consists of a Super Heavy booster with a Starship spacecraft atop it. The design is the largest ever launched, with double the thrust of NASA's own behemothic rocket, the Space Launch System. To achieve this thrust, the stages are filled with a combined 4,600 tons of liquid methane and liquid oxygen kept at cryogenic temperatures.

The concern is that one could explode on the pad or just above it. A study, "Investigating the Explosive Hazard of Liquid Oxygen-Liquefied Natural Gas Rocket Propellant," published by the NASA Engineering and Safety Center in 2023, described the explosive potential of its mixture, which is different from the kerosene-oxygen combination of most previous rockets. It found that even small amounts of methane-oxygen "have shown a broad detonable range with yields greater than that of TNT" but noted that "very little explosive data is currently available." Testing is underway to investigate the issue.

Starships are currently launched from Starbase, which is just a few kilometers from nearby residences that are evacuated on launch days. Plans call for eventually launching Starships from Cape Canaveral

> “It’s not just SpaceX. Blue Origin, Rocket Lab — this reliance on space assets is just going to grow. Our civilization is just going to need it more and more.”
>
> **— Michelle Hanlon, University of Mississippi’s School of Law**

in Florida and recovering them there as part of NASA’s Artemis program to return to the moon.

Wayne Eleazer, a retired U.S. Air Force lieutenant colonel, says the possible explosive potential yield of the rocket if something were to go wrong is “beyond anything else that anybody is operating,” with possible risks for local infrastructure and even life.

“When the rocket is on the pad, it’s a giant bomb,” says Abhi Tripathi, an aerospace engineer at the Space Sciences Laboratory at the University of California, Berkeley and a former mission director at SpaceX.

One aspect of Starship that has been studied is the noise the vehicle produces when it is launched and by the large Super Heavy booster on its return — something SpaceX demonstrated for the first time in October on the fifth test flight by catching Super Heavy in the “chopstick” arms of the launch tower.

Kent Gee, a professor of physics from Brigham Young University in Utah, has been studying Starship’s noise. For the fifth Starship flight, he monitored the noise at various distances by placing laboratory-quality microphones inside foam windscreens positioned 10 to 35 kilometers from the pad.

“It was the equivalent of four to six SLS launches, or at least 10 Falcon 9 launches,” he says. “It produces more acoustical energy than any other rocket that’s ever flown.”

The impact of that sound blast on the local environment is still an open question. “You’re starting to approach levels that are associated with an elevated risk of structural damage,” Gee says. “If you were close enough, there’s a potential for hearing loss.”

The returning booster also produces a sonic boom over land as it decelerates through the sound barrier, something that the Concorde airliners were famously not allowed to do.

While Starship launches are few and far between for now, the plan for multiple launches per day has not gone over well in some quarters. “People don’t want to have an Earth-shattering sonic boom every week for the rest of their life,” says Roesch. “They will lose their minds.”

Other environmental issues abound, including about the effects of the water deluge system used by SpaceX to dampen the heat of the Super Heavy engines. During liftoff, 1.6 million liters of water are shot under the base of the booster. SpaceX said in a post on X in August that this deluge system uses “potable (drinking) water” and therefore doesn’t impact the local environment, but the Environmental Protection Agency disagrees and fined the company $148,378 in September for discharging wastewater without a permit.

Roesch strongly disagrees with SpaceX. He says even drinking water can contain contaminants such as chlorine that are harmful to natural waters like the wetlands at Boca Chica.

“If you buy a fish and put it into an aquarium with tap water, it’ll die,” he cautions.

SpaceX is also facing ongoing legal action from a consortium of environmental groups over the impact of Starship on the local environment, including the American Bird Conservancy, based in Virginia, which

▲ SpaceX launched the sixth Starship-Super Heavy in November, a month after the fifth flight test. The quick turnaround was partly because FAA allowed both flights to proceed under the same launch license.

Aerospace America/John Tylko

told me in an emailed response to questions about Starbase that it was "deeply concerned about the facility's impacts on wildlife." Jared Margolis, senior attorney at the Center for Biological Diversity in Arizona and another plaintiff on the legal claim, adds that there are other effects on the local population, including the inability of the local Carrizo/Comecrudo tribe to access sacred lands during Starship launch activities when closures are in place.

SpaceX did not respond to multiple requests for comment via email and phone.

These issues with Starship alone illustrate the challenges facing FAA, which must consider complex environmental impacts like these, as well as impacts on human life, in any launch or reentry license it grants. Hanlon cites an infamous launch in China in 1996, in which a rocket veered off course and crashed into a nearby village, reportedly killing hundreds of people.

"We do not want to turn into that," she says.

Without disregarding safety and the environment, there are potential solutions to the lengthy licensing process.

"I believe FAA needs more staff," says Monteith, something that SpaceX seemingly agrees with, based on a letter the company sent to the chairs and ranking members of the House Committee on Science, Space, and Technology and Senate Committee on Commerce, Science, and Transportation.

"It has been clear for some time that AST [FAA's Commercial Space Transportation Office] lacks the resources to timely review licensing materials," SpaceX wrote in the letter, which it also posted on X.

Currently, FAA has some 40,000 people, but only "a little over 100 work on space," says Nield, the former head of the Commercial Space Transportation Office. Increasing that number could help address regulatory queries and issues more adeptly and issue licenses more quickly.

Funding increases would help too. Of the agency's $12.7 billion operating budget in fiscal 2024, $42 million went toward space, or about 0.3% of the total budget.

"You could double those numbers and it wouldn't show up as more than a rounding error," says Nield. "But that could make a huge difference in terms of responsiveness and having enough people to cover all the launches and companies."

Another option would be to tweak FAA's role in licensing launch and reentry. "More resources can help, but there's other things like just the placement of the Office of Commercial Space Transportation in the organizational structure that could make a huge difference," says Nield. "I'd love to see that kind of option considered."

Perhaps its role could even be removed entirely. "A lot of policymakers say everything should go to the Department of Commerce," notes Hanlon.

And then there's the Musk role in the new presidential administration.He and pharmaceutical entrepreneur Vivek Ramaswamy have agreed to head a planned Department of Government Efficiency, or DOGE, a nod to a cryptocurrency of the same name. As the idea stands, DOGE would be an advisory entity, not a new department in the federal government. Its aim will be to curb government spending, and while Musk's exact intent is unknown, FAA could be an entity firmly in his sights — despite SpaceX suggesting the agency needed more funding, not less.

Depending on how far Musk is allowed to go, there could be wholesale changes. "I think it's going to be open season on all regulations," says Tripathi. "You're going to see others take advantage of this under the new administration."

All eyes will be on whether Musk agrees. ★

Accelerating a Vision for AAM Certificati

BY NICK LAPPOS AND MIKE BORFITZ, AIAA CERTIFICATION TASK FORCE CO-CHAIRS

An opportunity exists to enable the development of airspace and air traffic control to integrate a potential air vehicle increase of up to 10 times the current population. Enabling this possibility, referred to by many as the Advanced Air Mobility (AAM) ecosystem, has inspired our work for many years. However, inviting this future requires the currently successful air traffic control system to reconsider its bandwidth, granularity, and reliance on airspace partitioning. As the AAM ecosystem develops, autonomy, artificial intelligence, and machine learning will become essential triggering technologies. The criteria used for aircraft certification and operations need to have a paradigm shift to enable these capabilities to be an integral part of attaining flight vehicle airworthiness certification and continued operational safety.

From 2022 to 2024, AIAA commissioned two task forces to explore opportunities for the organization to support the emerging AAM industry. The Advanced Air Mobility Task Force, chaired by Virginia Stouffer, considered topical priorities for resource development across AIAA's education initiatives. The Certification Task Force, which we co-chaired from 2023 to 2024, articulated the nuances involved with certifying and integrating novel aircraft into the national airspace.

Our report, "Challenges to the Commercialization of Advanced Air Mobility" at **aiaa.org/domains/aeronautics** draws upon

IN THEIR WORDS

AIAA organized a panel discussion at the Vertical Flight Society's AAM Infrastructure Workshop in September to share key recommendations from the "Challenges to the Commercialization of Advanced Air Mobility" report. Here are some edited highlights from the report:

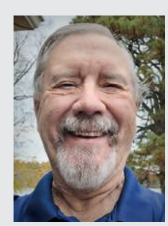
Nick Lappos

Technical Fellow, Advanced Technology, Sikorsky, A Lockheed Martin Company (Certification Task Force Co-Chair)

Wisely, the FAA has established a crawl, walk, run philosophy regarding the changes in the air traffic management (ATM) system as advanced airmobile aircraft are introduced. Today's system is the safest on the planet and adapts itself to the business needs and operational requirements of the air vehicles currently in service. For this reason, large changes to the ATM system should take place only as the business requirements grow and the need arises. As advanced airmobile vehicles are put to use, air traffic density will rise in urban areas, and with that rising density the need for major changes to the air traffic management system will occur.

Mike Borfitz

CEO, Kilroy Aviation (Certification Task Force Co-Chair)



Many AAM start-up companies don't have the depth of experience in FAA aircraft certification processes and procedures. The addition of new technology such as powered lift, energy density, and autonomous or remotely piloted flight contributes to the complexity of the type certification process, even for seasoned practitioners. The type certification process is iterative and frequently nonlinear; it can be painfully slow even when the applicant is deeply experienced and enjoys a healthy relationship with the FAA.

on and Airspace Integration Priorities

Advancing Aerial Mobility: A National Blueprint, a report published in 2020 by the National Academies of Sciences, Engineering, and Medicine. The report addresses unique requirements for certification and infrastructure, potential impacts on legal precedent and policy, and recommends a tutorial and mentorship series that could prepare new market entrants with foundational knowledge and tools needed to address the FAA's data requirements and safety concerns.

2025 is poised to be a critical year for the expansion of the domestic AAM ecosystem. The timing of this report defines a possible role for AIAA to convene stakeholder groups across the aerospace industry and support decision makers in knowledge sharing, just as the AAM Multistate Collaborative and AAM Interagency Working Group at the U.S. Department of Transportation plan to release a series of white papers on priorities for AAM operations. In addition to providing professional development support for the aerospace innovation community through its evolving needs as AAM operations mature, AIAA has an opportunity to educate decision makers and the general public about how to actualize a reality for national airspace that could expand access to goods and services for all Americans. Having concluded the task force efforts, AIAA is planning to expand its advocacy and engagement on implementing AAM. Please visit the AIAA Aeronautics Domain website (**aiaa.org/domains/aeronautics**) for more details about programming throughout the year. ★

Herb Schlickenmaier

President, HS Advanced Concepts LLC

Novel technologies are the antithesis of a proscriptive certification environment. After all, rules are meant to be met, not changed. The challenge is wrestling with the traditional role of standards development organizations, where the standards were based on data collected from existing industry and some government projects and products to allow harmonization to improve safety or economics. Under this new performance-based regulatory framework, standards are being developed prior to initial product introductions to support innovation, not harmonization.

James Grimsley

Executive Director of Advanced Technology Initiatives, Choctaw Nation of Oklahoma

If prescriptive laws are developed and adopted early in the development of the technologies, it is critical that these laws be "future-proofed." Laws that focus too heavily on the current state of the art can be rendered ineffective by technological developments. This poses a significant challenge to lawmakers. The existing complex legal framework for aviation in the United States has evolved over the past century. Some of this legal framework is now being challenged due to the emergence of novel aircraft systems that have the potential to operate in ways that are sometimes not possible with legacy aviation systems.

Rex Alexander

President, Five-Alpha LLC

There is a need for the FAA to define what each individual type of infrastructure, airport, heliport, and seaplane base is capable of supporting in regard to AAM operations and aircraft. This includes what type of ground equipment and fire safety equipment will be required at a traditional airport or heliport that intends to support electric, hybrid-electric, and/or hydrogen aircraft. We also will need to address the required equivalences for a vertiport that is intended to support other powered lift aircraft such as helicopters that may operate on either 100% liquid fuel or are configured as some sort of hybrid design.

ONLINE SHORT COURSES

LEARN FROM THE INDUSTRY'S LEADING EXPERTS

AIAA online courses help you stay sharp while strengthening your knowledge base. Special AIAA member rates are available for all courses and group discounts are available when five or more individuals from the same organization register for a course.

Spaceflight Physiology
Starts 3 February

Fundamentals of Python for Engineering Programming and Machine Learning
Starts 4 February

Atmospheric and Near-Earth Space Environment
Starts 6 February

Understanding Space: An Introduction to Astronautics and Space Systems Engineering
Starts 11 February

Business Development for Aerospace Professionals
Starts 11 February

Engineering and Operations for Planetary Field Geology
Starts 12 February

Test Foundations for Flight Test
Starts 18 February

Technical Writing Essentials for Engineers
Starts 24 February

Electric VTOL Aircraft Design: Theory and Practice
Starts 25 February

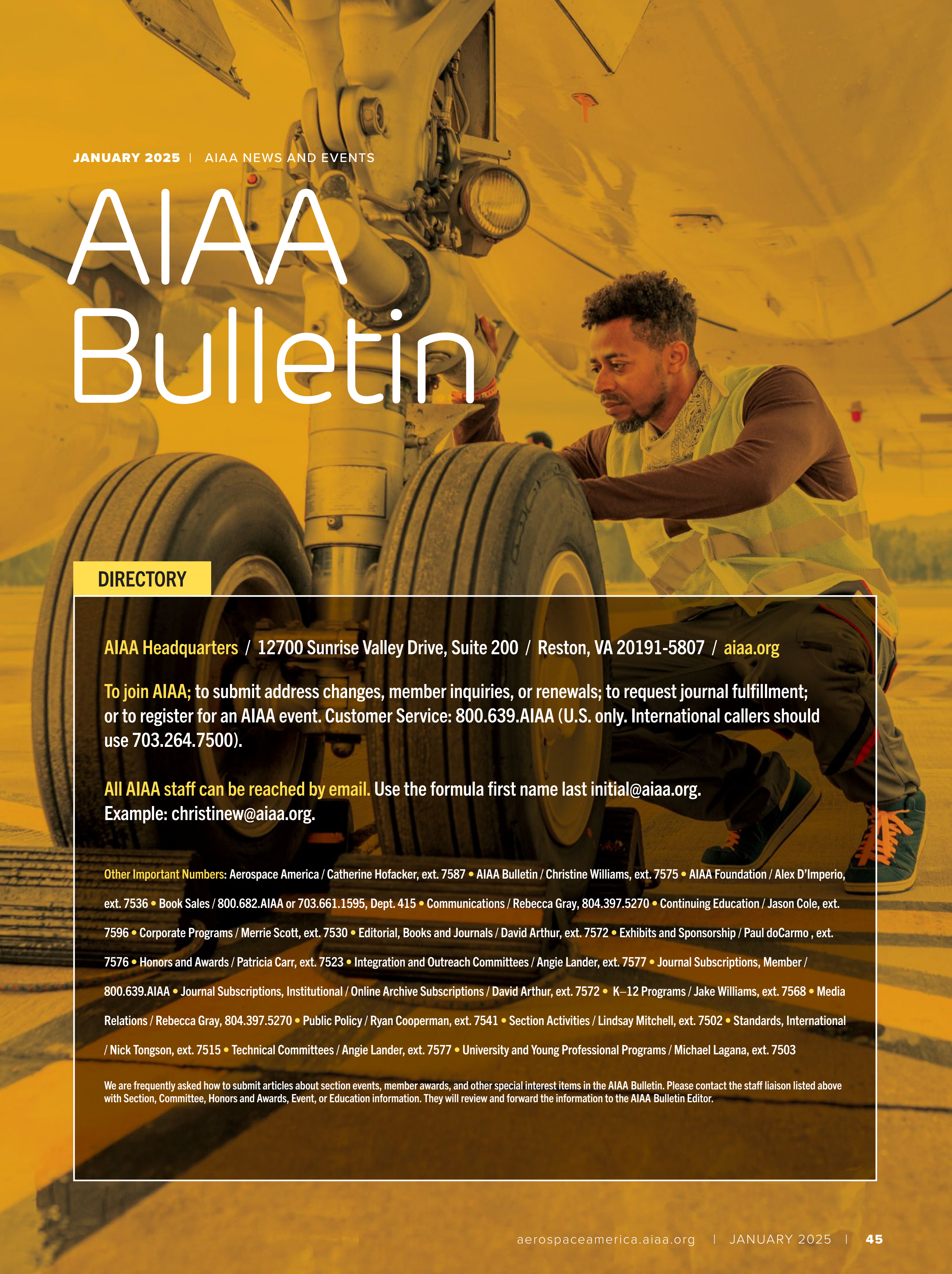
Cislunar Exploration: Challenges and Opportunities
Starts 3 March

Wind Tunnel Testing for Aircraft Development
Starts 4 March

Design of Space Launch Vehicles
Starts 10 March

Can't attend the live online lectures?
Most courses are available on demand.

BROWSE THE FALL CATALOG
learning.aiaa.org



AIAA Bulletin

DIRECTORY

AIAA Headquarters / 12700 Sunrise Valley Drive, Suite 200 / Reston, VA 20191-5807 / aiaa.org

To join AIAA; to submit address changes, member inquiries, or renewals; to request journal fulfillment; or to register for an AIAA event. Customer Service: 800.639.AIAA (U.S. only. International callers should use 703.264.7500).

All AIAA staff can be reached by email. Use the formula first name last initial@aiaa.org. Example: christinew@aiaa.org.

Other Important Numbers: Aerospace America / Catherine Hofacker, ext. 7587 • AIAA Bulletin / Christine Williams, ext. 7575 • AIAA Foundation / Alex D'Imperio, ext. 7536 • Book Sales / 800.682.AIAA or 703.661.1595, Dept. 415 • Communications / Rebecca Gray, 804.397.5270 • Continuing Education / Jason Cole, ext. 7596 • Corporate Programs / Merrie Scott, ext. 7530 • Editorial, Books and Journals / David Arthur, ext. 7572 • Exhibits and Sponsorship / Paul doCarmo , ext. 7576 • Honors and Awards / Patricia Carr, ext. 7523 • Integration and Outreach Committees / Angie Lander, ext. 7577 • Journal Subscriptions, Member / 800.639.AIAA • Journal Subscriptions, Institutional / Online Archive Subscriptions / David Arthur, ext. 7572 • K–12 Programs / Jake Williams, ext. 7568 • Media Relations / Rebecca Gray, 804.397.5270 • Public Policy / Ryan Cooperman, ext. 7541 • Section Activities / Lindsay Mitchell, ext. 7502 • Standards, International / Nick Tongson, ext. 7515 • Technical Committees / Angie Lander, ext. 7577 • University and Young Professional Programs / Michael Lagana, ext. 7503

We are frequently asked how to submit articles about section events, member awards, and other special interest items in the AIAA Bulletin. Please contact the staff liaison listed above with Section, Committee, Honors and Awards, Event, or Education information. They will review and forward the information to the AIAA Bulletin Editor.

Calendar

FEATURED EVENT

26–27 FEBRUARY 2025

Houston, Texas

In this year of transitions — political, strategic, acquisitional, and mission-driven — 2025 ASCENDxTexas will focus on the innovation and adaptation necessary to navigate the evolving space economy. Some of the space industry's most distinguished leaders will lead these pivotal discussions, ranging from policy to commercial challenges and changing timelines. The next giant leap starts here.

ascend.events/ascendx/ascendxtexas

DATE	MEETING	LOCATION	ABSTRACT DEADLINE
2025			
6–10 Jan	AIAA SciTech Forum	Orlando, FL	23 May 24
6–10 Jan	26th AIAA International Space Planes and Hypersonic Systems and Technologies Conference	Orlando, FL	23 May 24
8 Jan	2025 AIAA Associate Fellows Induction Ceremony and Dinner	Orlando, FL	
19–23 Jan*	2025 AAS/AIAA Space Flight Mechanics Meeting	Kaua'i, HI (www.space-flight.org)	13 Sep 24
3 Feb–21 Apr	Space Flight Physiology Course	ONLINE (learning.aiaa.org)	
4–25 Feb	Fundamentals of Python for Engineering Programming and Machine Learning Course	ONLINE (learning.aiaa.org)	
6 Feb–10 Apr	Atmospheric and Near-Earth Space Environment Course	ONLINE (learning.aiaa.org)	
11–13 Feb	Understanding Space: An Introduction to Astronautics & Space Systems Engineering Course	ONLINE (learning.aiaa.org)	
11–20 Feb	Business Development for Aerospace Professionals Course	ONLINE (learning.aiaa.org)	
12 Feb–16 Apr	Engineering and Operations for Planetary Field Geology Course	ONLINE (learning.aiaa.org)	
18 Feb–13 Mar	Test Foundations for Flight Test Course	ONLINE (learning.aiaa.org)	
21 Feb	AIAA Los Angeles University Student Branches Mini-Conference 2025	Los Angeles, CA	
24 Feb–5 Mar	Technical Writing Essentials for Engineering Course	ONLINE (learning.aiaa.org)	
25 Feb–27 Mar	Electric VTOL Aircraft Design: Theory and Practice Course	ONLINE (learning.aiaa.org)	
26–27 Feb	ASCENDxTexas	Houston, TX	
1–8 Mar*	IEEE Aerospace Conference	Big Sky, MT (www.ieee.org)	1 Jul 24

For more information on meetings listed below, visit our website at aiaa.org/events or call 800.639.AIAA or 703.264.7500 (outside U.S.).

DATE	MEETING	LOCATION	ABSTRACT DEADLINE
2025			
4 Mar	50th Dayton-Cincinnati Aerospace Sciences Symposium	Dayton, OH (aiaa-daycin.org/DCASS/)	17 Jan 25
4–20 Mar	Wind Tunnel Testing for Aircraft Development Course	ONLINE (learning.aiaa.org)	
5–17 Mar	Cislunar Exploration: Challenges and Opportunities Course	ONLINE (learning.aiaa.org)	
10 Mar–16 Apr	Design of Space Launch Vehicles Course	ONLINE (learning.aiaa.org)	
17–20 Mar	Space Mission Operations Course	ONLINE (learning.aiaa.org)	
19 Mar*	HYSKY 2025 H2Hub Summit	ONLINE (www.hysky.org)	
20–21 Mar	AIAA Region I Student Conference	Montréal, Quebec, Canada	10 Jan 25
24 Mar–2 Apr	Digital Engineering Fundamentals Course	ONLINE (learning.aiaa.org)	
28–29 Mar	AIAA Region IV Student Conference	Dallas, TX	31 Jan 25
29–30 Mar	AIAA Region VI Student Conference	Irvine, CA	2 Feb 25
31 Mar–23 Apr	Fundamentals of Structural Dynamics Course	ONLINE (learning.aiaa.org)	
1–10 Apr	Systems Engineering and Artificial Intelligence for Aerospace Applications Course	ONLINE (learning.aiaa.org)	
3–4 Apr	AIAA Region II Student Conference	Greensboro, NC	3 Feb 25
3–4 Apr	AIAA Region V Student Conference	Minneapolis, MN	31 Jan 25
4–5 Apr	AIAA Region III Student Conference	Cincinnati, OH	8 Feb25
10–13 Apr	29th Design/Build/Fly Competition	Tucson, AZ (aiaa.org/dbf)	
15–18 Apr	AIAA DEFENSE Forum	Laurel, MD	15 Aug 24
29 Apr	2025 AIAA Fellows Induction Ceremony and Dinner	Washington, DC	
30 Apr	2025 AIAA Awards Gala	Washington, DC	
21–25 Jul	AIAA AVIATION Forum	Las Vegas, NV	21 Nov 24
22–24 Jul	ASCEND Powered by AIAA	Las Vegas, NV	21 Nov 24
10–14 Aug*	AAS/AIAA Astrodynamics Specialist Conference	Boston, MA (https://www.space-flight.org)	
14–19 Sep*	International Electric Propulsion Conference	London, UK (electricrocket.org)	1 Mar 25
29 Sep–3 Oct*	75th International Astronautical Congress	Sydney, Australia (iac2025.org)	28 Feb 25

**Meetings cosponsored by AIAA. Cosponsorship forms can be found at aiaa.org/events-learning/exhibit-sponsorship/co-sponsorship-opportunities.*

● AIAA Continuing Education offerings

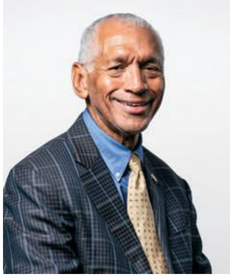
AIAA Announces Class of 2025 Honorary Fellows and Fellows

AIAA proudly congratulates its newly elected Class of 2025 Honorary Fellows and Fellows. The class will be inducted during a ceremony on Tuesday, 29 April, in Washington, DC, and celebrated during the AIAA Awards Gala on Wednesday, 30 April, at Grand Hyatt Washington, Washington, DC.

Honorary Fellow is AIAA's highest distinction, recognizing preeminent individuals who have made significant contributions to the aerospace industry and who embody the highest possible standards in aeronautics and astronautics. In 1933, Orville Wright became the first AIAA Honorary Fellow. Today, 245 people have been named AIAA Honorary Fellow.

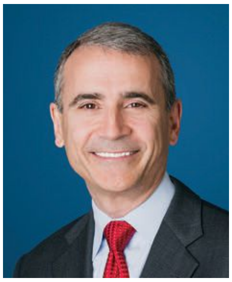
AIAA confers Fellow upon individuals in recognition of their notable and valuable contributions to the arts, sciences or technology of aeronautics and astronautics. Nominees are AIAA Associate Fellows. Since the inception of this honor 2,092 persons have been elected as an AIAA Fellow.

2025 AIAA Honorary Fellows



Maj. Gen. Charles F. Bolden Jr., USMC (Ret.), The Charles F. Bolden Group LLC

Alec Gallimore, Duke University



The Honorable Steven J. Isakowitz, The Aerospace Corporation

2025 AIAA Fellows

Maj. Gen. James B. Armor Jr., USAF (Ret.), The Armor Group LLC

Hamsa Balakrishnan, Massachusetts Institute of Technology

Brett A. Bednarcyk, NASA Glenn Research Center

John Maurice Carson III, NASA

Paul J. Cefola, University at Buffalo

Todd K. Citron, The Boeing Company

Stephen B. Clay, Air Force Research Laboratory

William A. Crossley, Purdue University

Boris Diskin, NASA Langley Research Center

Mary Lynne Dittmar, Axiom Space (retired) / Dittmar Associates

Stephen N. Frick, Lockheed Martin Space

Demoz Gebre-Egziabher, University of Minnesota

Luisella Giulicchi, European Space Agency

Vinay K. Goyal, The Aerospace Corporation

Michael J. Hirschberg, Vertical Flight Society

Tristram Tupper Hyde, NASA Goddard Space Flight Center

Oliver L.P. Masefield, SolvAero Consulting GmbH

Richard Gareth Morgan, University of Queensland

Natasha A. Neogi, NASA Langley Research Center

Robert Pearce, NASA

Mason Peck, Cornell University

Lisa J. Porter, LogiQ, Inc.

Joseph M. Powers, University of Notre Dame

Michael G. Ryschkewitsch, Johns Hopkins University Applied Physics Laboratory

Murray L. Scott, Advanced Composite Structures Australia

Philippe R. Spalart, Flexcompute

Paul F. Taylor, Gulfstream Aerospace Corporation

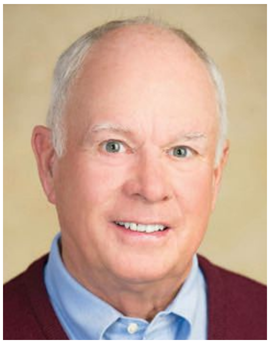
Manuel Torres, Lockheed Martin

AIAA Announces 2025 Sustained Service Awards Winners

AIAA has announced the winners of the 2025 Sustained Service Awards. The award recognizes sustained, significant service and contributions to AIAA by members of the Institute. The 2025 recipients are:

Steven X. Bauer, NASA Langley Research Center
For sustained leadership, service, and contributions to the Hampton Roads Section, Region I, and AIAA National.

Bauer became an AIAA student member in 1981. He served as a student branch officer and has held many positions in the Hampton Roads Section, including section chair. He was the Region I Director for six years. Bauer has worked at NASA Langley Research Center since 1983 and is retiring in December 2024.



Gene R. Dionne, Lockheed Martin Corporation (retired)
For his passionate, unmatched support of AIAA and the Rocky Mountain Section through volunteering across all committees.

Dionne spent 26 years in the U.S. Air Force, mostly in space systems acquisition and technology development. He was intimate in the manufacturing, integration, test and launch/on-orbit operations of ~30 satellites. Dionne spent 22 years at Lockheed Martin Space in systems engineering and program management. In 2014, he was selected as AIAA Fellow and he served on the Fellows Selection Committee for three years. He was AIAA Rocky Mountain Section Chair and continued to assist on the section's executive council for 20 years as "Fellow-at-large."

Trevor S. Elliott, University of Tennessee at Chattanooga
For prolific, dedicated, and outstanding service to AIAA forums, technical committees, student teams, outreach groups, rocketry organizations, and aerospace communities leading to numerous student-led recognitions.

Elliott is a UC Foundation Associate Professor of Mechanical Engineering at the University of Tennessee at Chattanooga. He serves as primary Faculty Advisor for the UTC Racing Mocs, SAE Chapter, and the UTC Rocket Mocs, where he has guided teams that have won national placement in collegiate competitions and set a world record in amateur rocketry. He is a member of the AIAA Solid Rockets Technical Committee and Hybrid Rockets Technical Committee chair and technical discipline chair.

David C. Fleming, University of Michigan
For sustained service to the Cape Canaveral Section and Florida Institute of Technology Student Branch through continued participation, council leadership, and unwavering dedication to AIAA's mission.

Fleming earned a B.S. degree in Aeronautics and Astronautics from MIT and M.S. and Ph.D. degrees from the University of Maryland, College Park. He served on the faculty of the Florida Institute of Technology for 28 years, including a term as department head. Fleming was faculty adviser of the AIAA Florida Tech Student Branch for over 25 years. Currently, he serves as Lecturer at the University of Michigan.

Aaron L. Harcrow Jr., No Box Innovations
For over 30 years of outstanding and sustained service to the Atlanta Section and Region II, contributing to the success of the Section.

Harcrow joined AIAA as a student member in 1981 and regards his 42-plus-years membership as a learning experience in the many ways to volunteer for AIAA, for which there appears to be no end in sight! He has developed multidisciplinary skills in aerospace engineering, systems engineering, project management, innovative design, product development, CAD/CAM/CNC, computer programming, and teaching undergraduate engineering courses, and he holds one USPTO patent.

Christopher J. Pestak, HX5, LLC

For dedicated service to AIAA and the field of aerospace for over 40 years, and holding significant leadership positions within AIAA.

Pestak is Program Manager of the Glenn Engineering and Research Support (GEARS) contract for HX5, LLC. He manages 350 staff supporting NASA Glenn Research Center performing wide-ranging work in space and aeronautics. Spaceflight systems have been a primary focus of his 42-year career. Pestak holds a B.S. in Electrical Engineering and an M.S. in Industrial Engineering, both from Cleveland State University. He is an AIAA Fellow.

Robert W. Pitz, Vanderbilt University

For over three decades of distinguished and continuous service to AIAA, especially in national leadership roles involving publication, honors, ethics, and technical committee activities.

Pitz has mechanical engineering degrees from Purdue University (B.S.) and UC Berkeley (M.S. and Ph.D.). After five years at GE Research, he joined Vanderbilt University where he is a Professor in the Department of Mechanical Engineering and served as Department Chair (1998–2017). He won the NSF Presidential Young Investigator Award (1987) and AIAA Best Paper Award in Propellants & Combustion (1996). Pitz is an AIAA Fellow, and also a Fellow of ASME and the Combustion Institute.

MAKING AN IMPACT

AIAA Announces 2024 Region VII Student Conference Winners

AIAA has announced the winners of the 2024 Region VII Student Conference, held 25–26 November at Swinburne University of Technology, Melbourne, Australia, and online. Attendees presented 46 papers and represented 20 universities. The conference had a strong international presence with students from 11 countries including Australia, Bangladesh, China, India, Israel, Japan, New Zealand, Nigeria, South Korea, Turkey, the United Kingdom, and the United States. Students presented papers in four categories: high school/secondary school, undergraduate, masters, and undergraduate team. Their presentations were evaluated by industry peers with experience in the aerospace sector. Papers presented at the conference will be published by AIAA and available on Aerospace Research Center (ARC) in January 2025.

For the undergraduate, masters, and undergraduate team categories, first-place winners received a cash prize of $500 and an invitation to participate in the International Student Conference during the 2025 AIAA SciTech Forum, 6–10 January. Second-place winners received a cash prize of $300 and third-place received $250. The high school students received $100 for first place, $75 for second place, and $50 for third place.

2024 AIAA Region VII Student Conference Paper Winners

High School Category

- 1st Place: Anay Ashwin, Haileybury College, Australia, "Venna Regolith Sample Acquisition Device - A Novel Proof of Concept for Lunar Rovers"
- 2nd Place: Henri Kim, Seoul Foreign School, South Korea, "Effects of Boeing 767 Winglet Types on Flight Efficiency: A Computational Fluid Dynamics Approach"
- 3rd Place: Cheney Wu and Nate Osikowicz, Cranbook Schools, United States, "An Airfoil Tensegrity Design: Concept, Algorithm Development, and Programming Implementation"

Undergraduate Category

- 1st Place: Said Mouhaiche and Anne Bettens, University of Sydney, Australia, "Lazily Reformulating Design Optimization as a Classification Problem"
- 2nd Place: Leon Phillips and Daniel Edgington-Mitchell, Monash University, Australia, "Investigating the Influence of Separate Propellant Streams in Rotating-Detonation Engine Injectors"
- 3rd Place: Thomas Finley and Daniel Edgington-Mitchell, Monash University, Australia, "Modelling and Schlieren Analysis of Shock Wave Reflections Over a Turbine Cascade"

Masters Category

- 1st Place: Zhen Hong Chai and Tulasi Parashar, Victoria University of Wellington, New Zealand, "Performance Insights into Applied-Field Magnetoplasmadynamic Thrusters with the Princeton AF-MPD Database"
- 2nd Place: Shiva Jogu and Karan Das, Amity University, India, "Mitigating Shock Wave Challenges through Secondary Recirculation in Mixed Compression Supersonic Air Intake"
- 3rd Place: Serika Yokoyama and Kikuko Miyata, Meijo University, Japan, "Discussion on Autonomous Sensor Data Selection Method for Planetary Rover Localization and its Verification"

Team Category

- 1st Place: Hardit Saini, Milcha Masresha, Andrews Agyei, Raima Rahman, Omar Abdi, Aamna Abbasi, Imad Foughali, and Eldad Avital, Queen Mary University of London, United Kingdom, "Small Horizontal Axis Wind Turbine Aerodynamic-Structural Design for Improved Performance Using Gurney Flaps"
- 2nd Place: Asif Hasnayeen, Md Redwan Iqbal, Farhan Syeed, Morsalin Sheikh, and Gp Capt A N Somanna, Military Institute of Science and Technology, Bangladesh, "Construction of a Small Fixed Wing UAV for Surveillance"
- 3rd Place: Lisa Dsouza, Adithya Vijay, Pranay Agrawal, Ullas AJ, Katkam Naveen, Anurag Kumar Jha, and NK Gahlot, Amity University, India, "Numerical Analysis of Pintle Nozzle Geometry Optimization for Improved Thrust in Rocket Engines"

AIAA student conferences are an opportunity for students to present and publish their work in front or their peers and members of the industry. Each of the AIAA seven regions host one conference each year. The Regional Student Conferences for Regions I-VI will take place in spring 2025. The AIAA Foundation sponsored this conference.

"Soaring High – Through the Decades" — Northern Ohio Section's 30th Annual Young Astronaut Day

PHOTOS: EDMOND WONG

Young Astronaut Day, which started in 1992, is a STEM outreach event for students in grades 1st-12th. Held by the AIAA Northern Ohio Section on 2 November, students had the opportunity to work as a team to solve engineering challenges, ranging parachute drops and balloon cars to Lego robots. Competing teams are tasked to complete three activities that create one mission within a two-hour period, requiring them to build strong teamwork, communication, and critical thinking skills. Through these STEM activities and interacting with the scientists and engineers who are leading the activities and volunteering, students are educated and inspired by NASA and the STEM field.

AIAA Sydney Section Dives into an Aviation Mystery

On 7 November, Glenn Horrocks from NSW SES Bush Search and Rescue was hosted by the AIAA Sydney Section to discuss the 40+-year search for a missing plane. The Cessna 210 VH-MDX disappeared in August 1981 as it was flying to Sydney over national parkland.

Despite annual searches by NSW SES Bush Search and Rescue and efforts of other groups, the airplane and its occupants have still not been found. During Horrocks' own 30-year research efforts searching for the lost airplane, GPS technology and communications have come a long way, and current searches for the aircraft also are used as training exercises for State Emergency Service volunteers

AIAA Sydney Section Chair Tjasa Boh Whiteman has been an SES volunteer since 2019 and she is confident that aviation science and the almost 200 AIAA members in NSW can assist looking the airplane, using their technical knowledge to fill in gaps. More information about the mystery and current search can be found at **www.facebook.com/AIAASydneySection**.

AIAA NEWS


Darryl Newhouse, 2024 Trailblazing STEM Educator Award Winner

"The world is changing very fast. Our kids need to get on board and be part of the technology of the future and part of the creation of that technology. It's important that we give kids opportunities... I tell my students 'do the math; save the world!'"

AIAA Foundation Day of Giving Surpasses Goal!

The AIAA Foundation celebrated its third annual Day of Giving on 3 December 2024, and with the support of 88 generous donors, we surpassed our fundraising goal, raising $126,000! These funds will help fuel the aspirations of the next generation of aerospace innovators and explorers.

Thanks to the continued generosity of the AIAA community, the Foundation will be able to provide over $160,000 annually in scholarships and graduate awards to high school seniors and university students. Additionally, we will distribute $77,000 each year in K-12 educator awards and grants, supporting hands-on programs like Design/Build/Fly, student conferences, and so much more.

There's still time to make a difference! To contribute to the AIAA Foundation and help shape the future of aerospace, visit **aiaa.org/foundation**.

Author name: Michael Hankins

https://mwhankins.com/

Title: *Flying Camelot: The F-15, the F-16, and the Weaponization of Fighter Pilot Nostalgia*

Award: Presented for the best original contribution to the field of aeronautical or astronautical non-fiction literature published in the last five years dealing with the science, technology, and/or impact of aeronautics or astronautics on society.

Description: *Flying Camelot* brings us back to the post-Vietnam era, when the U.S. Air Force launched two state-of-the-art fighter aircraft: the F-15 Eagle and the F-16 Fighting Falcon. It was an era when debates about aircraft superiority went public—and these were not uncontested discussions. Hankins, a curator at the National Air and Space Museum, delves deep into the fighter pilot culture that gave rise to both designs, showing how a small but vocal group of pilots, engineers, and analysts in the Department of Defense weaponized their own culture to affect technological development and larger political change.

Spotlight on the 2025 Gardner-Lasser Aerospace History Literature Award Winner

Why did you write this book?

I knew I wanted to write about the F-15 and F-16 fighters, both because I found them inherently interesting, and because they represented a moment when the U.S. Air Force changed the types of aircraft it developed – moving away from multirole airplanes and toward more specialized systems. The more I read about the development of these aircraft, the more I discovered these stories of seemingly over-the-top fighter pilots and similarly-minded people caught in this culture clash with larger defense institutions. I got hooked on exploring those conflicts. As I looked at more historical evidence, these stories also proved to be a good opportunity to combine ideas from other sub-fields of history as well as to reevaluate some important Air Force figures.

Who should read it?

I would hope that anyone who is a bit of a nerd for airplanes (like myself) would enjoy this book. If you grew up building model airplanes or looking at those coffee table aircraft books, then you might enjoy *Flying Camelot*. But as I was writing it, I had a few other specific audiences in mind. First, I was hoping that people involved in the design, development, and procurement of military technology might get some insight from this book about the ways that culture shapes our choices about technology design. Second, I was hoping to build, or at least strengthen, a bridge between historians of technology and more traditional military historians. I think those two fields have a lot to say to each other, and would benefit from talking more.

What's next for you?

I have written chapters that will be included in a few multi-author volumes coming out soon, and some of those are about issues in *Flying Camelot* that I wanted to explore further, like how fighter pilot culture changed over time, and how the F-15 and F-16 were marketed and presented publicly. I'm also working on a second book that looks at the development of stealth aircraft technology, which I'm very excited about.

NASA's Nicola Fox Keynoted YPSE Conference

The AIAA Mid-Atlantic Section hosted its annual Young Professionals, Students, and Educators Conference (YPSE) on 22 November in Laurel, MD. This conference brings together students, educators, and young professionals to share their work and make connections within the broader aerospace industry. This year Nicola Fox, Associate Administrator, Science Mission Directorate, NASA, gave the technical keynote on NASA's vision for powerful science. Alice Corcoros, Dragonfly Lidar Sensor Lead, Johns Hopkins University Applied Physics Laboratory, and SES Diversity Advisory Team (DAT) Chair, spoke on the current state of DEIA in aerospace and what can be done to keep moving forward. Also included in the day's events was a panel on national security space in the United States. The highlight of the day for many was the Dragonfly Test Platform Display and Demo, which was demonstrated outside as a crowd of attendees looked on.

Details for the 2025 YPSE can be found at **aiaaypse.com**.

Obituaries

AIAA Associate Fellow Karman Died in February 2024

Steve L. Karman died on 25 February 25. He was 64 years old.

Karman attended the Air Force Academy for a year before transferring to Texas A&M to complete his bachelor's and master's degrees. He received a Ph.D. in Aerospace Engineering from the University of Texas at Arlington in 1991, while working full-time at General Dynamics.

During his career Karman developed technology for solving the Navier-Stokes equations over complex geometries. He also focused on developing methods for generating unstructured grids, and he contributed several innovative and unique algorithms, including viscous-layer insertion, elliptic smoothing incorporating the Winslow equations, virtual control volumes, geometry parameterization, and most recently, the currently only viable means for curving meshes for high-order simulations. Karman was an active member of AIAA, writing numerous papers, organizing and chairing sessions at conferences, serving on technical committees (Fluid Dynamics TC, Meshing, Visualization and Computational Environments TC, and Applied Aerodynamics TC), and actively participating in workshops.

Associate Fellow Norman Died in November 2024

Wendell S. Norman died on 4 November. He was 91 years old.

Norman received his BSME from the University of Kentucky. He received his M.S. and Ph.D. in aeronautical engineering from Purdue University. As a 1st Lieutenant in the U.S. Air Force, he taught aerodynamics, flight mechanics, and space flight mechanics at the U.S. Air Force Academy. He spent many years working with the Sverdrup Corporation at the Arnold Engineering Development Center (AEDC) in Tullahoma where he held several management positions and also served as general manager for the Test Operations Division and as chief scientist.

When Sverdrup was awarded a contract with NASA Lewis Research Center, Norman was made general manager and later vice president with a staff that grew to 600. Sverdrup provided scientific and technical support for NASA Lewis' efforts in propulsion, space experiments, structural analysis, aerodynamics research, facilities operations, and computer support. After seven years in Cleveland, Norman became senior vice president with Sverdrup with corporate oversight responsibility for contract operations in Ohio, Florida, and Utah.

An AIAA Associate Fellow, Norman also was a member of ASME and the Tennessee Society of Professional Engineers. He was an adjunct professor at the University of Tennessee Space Institute (1964–1983), and he served on the Engineering Accreditation Commission (1980–1989) and the Executive Committee (1983–1985), traveling to U.S. universities to evaluate engineering programs. His awards included the Distinguished Engineering Alumni Award (1978) and Outstanding Aerospace Engineer for the School of Aeronautics & Astronautics (1999) both from Purdue, and AEDC Fellow from Arnold Engineering Development Center (2004).

AIAA Student Branches, 2024–2025

AIAA has more than 240 student branches around the world. Each branch has a chair elected each year, and a faculty advisor who serves long term to support that branch's activities. Like the professionals, the student branches invite speakers, take field trips, promote career development, and participate in projects and competitions that introduce students to membership with AIAA and their professional futures. The branches, and their officers in particular, organize branch activities in addition to their full-time schoolwork, and their advisors clearly care deeply about their students' futures. Please join us in acknowledging the time and effort that all of them take to make their programs successful.

FA = Faculty Advisor
SBC = Student Branch Chair
* = Provisional Charter

Region I

American Public University System
FA: Kristen Miller
SBC: Jonathan Portuesi

Boston University
FA: Sheryl Grace
SBC: Emma Braatz

Catholic University of America
FA: Diego Turo

City College of New York
FA: Oleg Goushcha
SBC: Kathrine Owens

Clarkson University
FA: Nick Tepylo
SBC: Nathaniel Maitland

Columbia University
SBC: Luca Nashabeh

Concordia University, Canada
FA: Hoi Dick Ng

Cornell University
FA: Dmitry Savransky
SBC: Christopher Chan

Drexel University
FA: Ajmal Yousuff
SBC: Naveen Thomas Ninan

École de Technologie Supérieure Montréal, Canada
FA: Ruxandra Botez
SBC: Mouhamadou Wade

George Mason University *
FA: Mary Cummings
SBC: Kareem Zahran

George Washington University
FA: Peng Wei
SBC: Pat Burke

Hofstra University
FA: John Vaccaro

Howard University
FA: Nadir Yilmaz

Lehigh University
FA: Terry Hart
SBC: Kevin Jun

Manhattan College
FA: Lian Walker
SBC: Amelia Mantauno
SBC: Stephen Peluso

Massachusetts Institute of Technology
FA: Julie Shah
SBC: Dinuri Rupasinghe

New York Institute of Technology
FA: James Scire

Northeastern University
FA: Andrew Gouldstone
SBC: Cameron Bracco

NYU Tandon School of Engineering
FA: Nicholas DiZinno

Old Dominion University
FA: Colin Britcher
SBC: Daniel Tapajna

Pennsylvania State University
FA: Mark Miller
SBC: Ansh Shah

Princeton University
FA: Michael Mueller
SBC: Michael Hwang

Rensselaer Polytechnic Institute
FA: Farhan Gandhi
SBC: Diego Herrera

Rochester Institute of Technology
FA: Agamemnon Crassidis
SBC: Matthew Bellantoni

Rowan University
FA: Nand Singh
SBC: James Keenan

Rutgers University
FA: Edward DeMauro
SBC: Andrew Huth

Southern New Hampshire University
FA: Xinyun Guo
SBC: Jared Castillo

Stevens Institute of Technology
FA: Jason Rabinovitch
SBC: Christina Alexandrov

Stony Brook University
FA: Foluso Ladeinde
SBC: Angel Matos

Syracuse University
FA: John Dannenhoffer
SBC: Theodore Todorov
SBC: Tatiyyanah Nelums

Toronto Metropolitan University, Canada
FA: Seyed Hashemi
SBC: Sarina Sohaili Yekta

United States Military Academy-West Point
FA: Drew Curriston
SBC: Gabriel Ester

United States Naval Academy
SBC: Taher Telfah
FA: Eric Brogmus

University at Buffalo
FA: Aaron Estes
SBC: Frank Robles

University of Connecticut
FA: Chih-Jen Sung
SBC: Adam Florkiewicz

University of Hartford*
FA: Paul Slaboch
SBC: Christian Piscitelli

University of Maine
FA: Alexander Friess
SBC: William Brown

University of Maryland, Baltimore County
FA: Charles Eggleton
SBC: Steven Sparks

University of Maryland College Park
FA: Alison Flatau
SBC: Marissa Potts

University of Massachusetts Lowell
FA: David Willis
SBC: Aidan Skidmore

University of Pittsburgh
FA: Matthew Barry
SBC: Carter Gassler

University of Rhode Island*
FA: Bahram Nassersharif
SBC: Daniel Borden

University of Toronto, Canada
FA: Kamran Behdinan
FA: Hugh Liu

University of Vermont
FA: William Louisos
SBC: Seamus Howrigan

University of Virginia
FA: Christopher Goyne
SBC: John Vietmeyer

Vaughn College of Aeronautics and Technology
FA: Amir Elzawawy
SBC: Utsav Shah

Villanova University
FA: Sergey Nersesov
SBC: Jafet Beltran

Virginia Commonwealth University*
FA: Bradley Nichols
SBC: Joseph Lee

Virginia Tech
FA: Greg Young
SBC: Noah Charness

Wentworth Institute of Technology
FA: Haifa El-Sadi
SBC: Sean Perkins

West Virginia University
FA: Christopher Griffin
SBC: Nathan Lang

Worcester Polytechnic Institute
FA: Zachary Taillefer
SBC: Paige Rust

Region II

Alabama A&M University
FA: Zhengtao Deng

Athens State University
FA: J. Wayne McCain
SBC: Brittney Smith

Auburn University
FA: Brian Thurow
SBC: Austin Miranda

East Carolina University
FA: Tarek Abdel-Salam
SBC: Jacob Rose

Embry-Riddle Aeronautical University Worldwide
FA: Robert Deters
SBC: Dallas McNeal

Embry-Riddle Aeronautical University-Daytona Beach
FA: Ebenezer Gnanamanickam
SBC: Andrew Bunn

Florida A&M University
FA: Chiang Shih

Florida Atlantic University
FA: Oscar Curet
SBC: Sky Rueff

Florida Institute of Technology
FA: Paula do Vale Pereira
SBC: Daria Astaire

Florida International University
SBC: Gabriel Herrera

Florida State University
FA: Chiang Shih
SBC: Carter Thomas

Georgia Institute of Technology
FA: Dimitri Mavris
SBC: Ethan Traub

Kennesaw State University
FA: Cameron Coates
FA: Gaurav Sharma
SBC: Kenneth Kubiak

Louisianna State University
FA: Shyam Menon
SBC: Wesley Hutcherson

Mississippi State University
FA: Robert Wolz
SBC: Daniel Hurley

North Carolina A&T State University
FA: Mookesh Dhanasar
SBC: Corey Wells

North Carolina State University
FA: Jack Edwards
SBC: Landon Hiatt

Polytechnic University of Puerto Rico
FA: Jose Pertierra
SBC: Gabriela Díaz

Tennessee Technological University
FA: John Tester
SBC: Adam Guillory

Tuskegee University
FA: Mohammad Khan
SBC: Camelia Ingram

University of Alabama at Birmingham
FA: Roy Koomullil
SBC: Taha Mohmoud

University of Alabama-Huntsville
FA: Kunning Xu
SBC: Ella Hazle

University of Alabama-Tuscaloosa
FA: Weihua Su
SBC: James Mathies

University of Central Florida
FA: Jeffrey Kauffman
SBC: Emma Levenson

University of Florida Gainesville
FA: Richard Lind
SBC: James Bautista

University of Georgia
FA: Ramana Pidaparti
SBC: Leah Madsen

University of Memphis
FA: Daniel Foti
SBC: Sophie Wood

University of Miami Coral Gables
FA: Giacomo Po
SBC: Adam Abdelkhalek

University of Mississippi
FA: Jeff Rish

University of North Carolina at Charlotte
FA: Artur Wolek
SBC: Kyle VanHorn

University of Puerto Rico
FA: Sergio Preidikman
SBC: Ernesto Forteza

University of South Alabama
FA: Carlos Montalvo
SBC: Matthew Van Welzen

University of South Carolina
FA: Wout De Backer
SBC: Michael Cargill

University of Tennessee Chattanooga
FA: Kidambi Sreenivas
SBC: Morgan Young

University of Tennessee Knoxville
FA: Damiano Baccarella
SBC: Hailey Henderlight

University of Tennessee Space Institute
FA: Phillip Kreth
SBC: Zane Shoppell

University of West Florida
FA: Michael Reynolds
SBC: Aza Boykin

Vanderbilt University
FA: Amrutur Anilkumar
SBC: Zachary Friedman

Region III

Air Force Institute of Technology
FA: Marc Polanka
SBC: Emma Webb

Case Western Reserve University
FA: Paul Barnhart
SBC: David Kuhtenia

Cedarville University
FA: Joseph Miller
SBC: Seth Mitchell

Cleveland State University
FA: Wei Zhang
SBC: Alex Reigle

Illinois Institute of Technology
FA: Murat Vural
SBC: Khang Pham

Indiana University-Purdue University Indianapolis
FA: Hamid Dalir
SBC: Oluwaseun Omole

Kettering University
FA: Bashar AbdulNour

Lawrence Technological University
FA: Andrew Gerhart

Miami University, Ohio
FA: Edgar Caraballo
SBC: Nathan Bonney

Michigan State University
SBC: Jake Rutkowski
FA: Patton Allison

Michigan Technological University*
FA: Kazuya Tajiri
SBC: Marcello Guadagno

Milwaukee School of Engineering
FA: William Farrow
SBC: Elizabeth Kuhn

Ohio Northern University
FA: Craig Murray
SBC: Aaron Hess

Ohio State University
FA: Ali Jhemi
SBC: Maya Sivakumaran

Ohio University
FA: Jay Wilhelm
SBC: Michael Variny

Purdue University
FA: Li Qiao
SBC: Daniel Cyze

Rose Hulman Institute of Technology
FA: Matthew Riley
SBC: Tanner DeKruyter

Trine University
FA: Jon Koch
SBC: Noah Thompson

University of Akron
FA: Alexander Povitsky
SBC: Reece Davis

University of Cincinnati
FA: Bryan Kowalczyk
SBC: Jackson Hennegan

University of Dayton
FA: Sidaard Gunasekaran
SBC: Michael Foster

University of Illinois-Chicago
FA: Kenneth Brezinsky
SBC: Hannah Swanson

University of Illinois-Urbana-Champaign
FA: Laura Villafañe Roca
SBC: Luke McNamara

University of Kentucky-Lexington
FA: Alexandre Martin
SBC: Hawthorn Carson

University of Kentucky-Paducah
FA: John Maddox
SBC: Marshall Jenkins

University of Michigan
FA: Benjamin Jorns
SBC: Matt Nurick

University of Notre Dame
FA: Thomas Juliano
SBC: Yamato Ikeda

University of Wisconsin Madison
FA: Jennifer Choy
SBC: Eugene O'Brien

University of Wisconsin Milwaukee
FA: Ryoichi Amano
SBC: Omar Habash

Western Michigan University
FA: Kapseong Ro
SBC: Derek Martindell

Wright State University
FA: Mitch Wolff
SBC: Caleb Wasserbeck

Youngstown State University
FA: Stefan Moldovan

Region IV

Lamar University
FA: Chun-Wei Yao
SBC: Jonah Watts

New Mexico Institute of Mining and Technology
FA: Mostafa Hassanalian
SBC: Shawna Dodge

New Mexico State University
FA: Andreas Gross
SBC: Amber Diaz

Oklahoma State University
FA: Andrew Arena
SBC: Landon Dowers

Rice University
SBC: Nancy Lindsey

Tarleton State University*
FA: Hyedi Viehmann
SBC: Ashlan Benson

Texas A&M University
FA: Manoranjan Majji
SBC: Timothy Jeter
SBC: Ethan Graef

Universidad Autonoma de Baja California, Mexico
FA: Juan Antonio Paz
SBC: Christian Sanchez

Universidad Autonoma de Chihuahua, Mexico
FA: Carlos Sanchez
SBC: Oscar Garcia

University of Arkansas-Fayetteville
FA: Po-Hao Huang
SBC: Ethan Graef

AIAA Student Branches, 2024–2025 (continued)

University of Houston
FA: Marzia Cescon
SBC: Isabel Ngiraidong

University of New Mexico
FA: Heng Zuo
SBC: Erin Lawlor

University of Oklahoma
FA: Ramkumar Parthasarathy
SBC: Nicholas Khor

University of Texas Arlington
FA: Julio Benavides
SBC: Jason Daugherty

University of Texas Austin
FA: Thomas Underwood
SBC: Jeffrey Wang

University of Texas Dallas
FA: Arif Malik
SBC: Jack Finnegan

University of Texas El Paso
FA: Joel Quintana
SBC: Cristian Gutierrez Altamira

University of Texas San Antonio
FA: Christopher Combs
SBC: Smruthi Shashidhar

Region V

Colorado School of Mines
FA: Angel Abbud-Madrid
SBC: Max Sheperd
SBC: Eva Christianson

Colorado State University
FA: Ben Grier
SBC: Michaella Burchici

Fort Lewis College*
FA: William Nollet
SBC: Ava Ream

Iowa State University
FA: Shahram Pouya
SBC: Karanvir Singh

Kansas State University
FA: Scott Thompson
SBC: Mohanish Andurkar

Metropolitan State University of Denver
FA: Jose Lopez
SBC: Marcus Stengel

Missouri University of Science and Technology
FA: Daoru Han
SBC: Jaden Carollo

Saint Louis University
FA: Michael Swartwout
SBC: Andrzej Kowalkowski

University of Calgary, Canada
FA: Craig Johansen
SBC: Raleigh Nolan

University of Colorado-Boulder
FA: John Mah
SBC: Conner Parker

University of Colorado-Colorado Springs
FA: Lynnane George
SBC: Jeremy Lee

University of Kansas
FA: Ronald Barrett-Gonzalez
SBC: Andrew Evans

University of Minnesota
FA: Yohannes Ketema
SBC: Jett Wong-Parker

University of Missouri Columbia
FA: Craig Kluever
SBC: Michael Mischkot

University of Missouri-Kansas City
FA: Mujahid Abdulrahim
SBC: Kaitie Butler

University of North Dakota
FA: Marcos Fernandez-Tous

Washington University in St Louis
FA: Swami Karunamoorthy

Wichita State University
FA: Linda Kliment
SBC: Joseph Macko

Region VI

Arizona State University
FA: Jeonglae Kim
SBC: Lucas Van Noord

Brigham Young University
FA: Steven Gorrell
SBC: Max Wirz

California Institute of Technology
FA: Soon-Jo Chung
SBC: Kevin Gauld

California Polytechnic State University-Pomona
FA: Subodh Bhandari
SBC: Jordan Van

California Polytechnic State University-San Luis Obispo
FA: Nandeesh Hiremath
SBC: Clara Greenberg

California State University, Fresno
FA: Deify Law
SBC: Philip Dayuday

California State University, Fullerton
FA: Haowei Wang

California State University, Long Beach
FA: Eun Jung Chae
SBC: Matthew Alpizar

California State University, Northridge
FA: Peter Bishay
SBC: Jeffrey Astorga

California State University, Sacramento
FA: Ilhan Tuzcu

Embry-Riddle Aeronautical University Prescott AZ
FA: David Lanning
SBC: Andre Leppert

Oregon State University
FA: John Greeven
SBC: Brayden Haldezos

Portland State University
FA: Andrew Greenberg
SBC: Rose Jardine

San Diego State University
FA: Pavel Popov
SBC: Yuichiro Tobita

San Jose State University
FA: Periklis Papadopoulos
SBC: Tyler Yuen

Santa Clara University
FA: Mohammad Ayoubi
SBC: Pietra Curro

Stanford University
FA: Juan Alonso
SBC: Anshuk Chigullapalli

University of Alaska Fairbanks
FA: Michael Hatfield
SBC: Casey Lambries

University of Arizona
FA: Jekan Thangavelautham
SBC: Rachel Rhomberg

University of California-Davis
FA: Zhaodan Kong
SBC: Shreya Chandra

University of California-Irvine
FA: Jacqueline Huynh
SBC: Vishnu Rajasekhar

University of California-Los Angeles
FA: Jeff Eldredge
SBC: Kyra Allen

University of California-Merced
FA: YangQuan Chen
SBC: David Hoehler

University of California-San Diego
FA: Mark Anderson
SBC: Jorge Vergara

University of Hawai'i at Mānoa*
FA: Trevor Sorensen
SBC: Casper MacDhomhnaill-Rurikovich

University of Nevada-Las Vegas
FA: Matthew Pusko
SBC: Christian Yuan

University of Nevada-Reno
FA: Aditya Nair
SBC: Darian Wong

University of Southern California
FA: Geoffrey Spedding
SBC: Dyllan Rodriguez

University of Utah
FA: Jacob Hochhalter
SBC: Vinit Dudani

University of Washington Seattle
FA: Mehran Mesbahi
SBC: Brayden Schwartz

Utah State University
SBC: Wyatt Daugs

Washington State University
FA: Jin Liu

Region VII

Ahsanullah University of Science and Technology, Bangladesh*
FA: Ishtiaque Hossain
FA: Mazharul Islam
SBC: Anas Al Rafin

Beihang University, China
FA: Zhiqiang Wan
SBC: Jing Pu

Chulalongkorn University, Thailand
FA: Joshua Staubs
SBC: Supakorn Suttiruang

Hong Kong University of Science & Technology, China
FA: Larry Li
SBC: Ho Hung Kan

Institute of Space Technology, Pakistan
FA: M. Sohail
SBC: Talha Najaf

Istanbul Technical University, Turkey
FA: Bariş Başpinar

Khalifa University of Science Technology and Research, United Arab Emirates*
FA: Ashraf Al-khateeb
SBC: Mohammad Hassan

King Fahd University of Petroleum and Minerals, Saudi Arabia*
FA: Ayman Abdallah
SBC: Housamaldean Alhoussawi

Korea Advanced Institute of Science and Technology, South Korea
FA: Eunji Jun
SBC: Gunmo Lee

Monash University, Australia
FA: Daniel Edgington-Mitchell
SBC: Sweta Balakrishna

Nitte Meenakshi Institute of Technology, India*
FA: Vinayaka Nagarajaiah
SBC: Sanvi Gaikwad

Queens University, Northern Ireland
FA: Danielle Soban

Royal Melbourne Institute of Technology, Australia
FA: Cees Bil
SBC: Rayan Perera

Sapienza Universita di Roma, Italy
SBC: Alessandro Cervelli

Universidad de Antioquia, Colombia*
FA: Diego Hidalgo Lopez
SBC: Mateo Lezama Fuentes

Universidad de San Buenaventura, Columbia
FA: Ruben Salazar
SBC: Eliana Hernandez

Universita di Naples Federico II, Italy
FA: Francesco Marulo

Universita di Roma - La Sapienza, Italy
FA: Daniele Bianchi

Universidad Pontificia Bolivariana, Colombia
FA: Juan Alvarado Perilla
SBC: Stefania Villa Ávila

University of Adelaide, Australia
FA: Harry Rowton
SBC: Zehao Liu

University of Canterbury, New Zealand
FA: Dan Zhao
SBC: Jack Davies

University of New South Wales Sydney, Australia
FA: Sonya Brown
SBC: Xiangyu Xu

University of Sydney, Australia
FA: Kee-Choon Wong
SBC: Macklin O'Reilly

USC Viterbi
School of Engineering

The University of Southern California invites applications for multiple tenured positions at the Associate Professor or full Professor rank in the Department of Aerospace and Mechanical Engineering (AME) (https://ame.usc.edu/) in the USC Viterbi School of Engineering (https://viterbischool.usc.edu/). Candidates must have demonstrated research excellence with external funding and sustained commitment to the discipline. An earned doctorate in Aerospace Engineering, Mechanical Engineering, or a closely related field, is required. Exceptional candidates may be considered for a chaired professorship. The USC Viterbi School is committed to increasing the diversity of our faculty and welcomes applications from women; persons of African, Hispanic and Native American descent; veterans; and persons with disabilities. Outstanding senior applicants who have demonstrated academic excellence and leadership, and whose past activities document a commitment to issues involving the advancement of women in science and engineering may be also considered for the Lloyd Armstrong, Jr. Endowed Chair, which is supported by USC's Women in Science and Engineering (WiSE) Program endowment.

Our Department's search this year aligns with USC's $1 billion Frontiers of Computing initiative, the largest, most comprehensive academic initiative in the university's history (http://computing.usc.edu). The initiative has already resulted in the creation of the USC School of Advanced Computing (see http://sac.usc.edu). It is expected that successful candidates will be affiliated with this new school. While applicants from all research fields will be considered, priority will be given to those whose research aligns with one or more of the following affinity areas: (i) Computational Science and Engineering; (ii) Sustainability and Computing; and/or (iii) Computational Medicine and Health. Applicants are required to incorporate into their research and teaching statements at least one page that clearly describes how their research and teaching interests and accomplishments align with at least one of these affinity areas. Applications that do not address the affinity area(s) in their statements will be considered incomplete and will not move forward in the selection process.

Positions are available starting August 16, 2025. Candidates should apply at https://ame.usc.edu/facultypositions. Application materials must include a cover letter, a curriculum vitae, statements of research and teaching interests (each up to 2 pages) and contact information for at least three references. Applicants are encouraged to include a succinct statement on fostering an environment of diversity and inclusion.

The USC Viterbi School of Engineering is among the top-tier engineering schools in the world. It counts 213 full-time, tenure-track faculty members. Faculty engage in interdisciplinary research through the School's research centers, including the Information Sciences Institute, the Institute for Creative Technologies, the Department of Homeland Security's first University Center of Excellence (CREATE), the National Center for Metropolitan Transportation Research (METRANS), the Center for Artificial Intelligence in Society (CAIS), and the Center for Advanced Manufacturing (CAM). The School is affiliated with the USC Stevens Center for Innovation. Our research expenditures typically exceed $177 million annually.

The annual base salary range for the following faculty ranks in this posting are:

- Associate Professor $136,000 - $165,000
- Full Professor: $174,000 - $236,000

When extending an offer of employment, the University of Southern California considers factors such as (but not limited to) the scope of responsibilities of the position, the candidate's work experience, education/training, key skills, internal peer equity, federal, state.

USC is an equal opportunity, affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, protected veteran status, disability, or any other characteristic protected by law or USC policy. USC will consider for employment all qualified applicants with criminal histories in a manner consistent with the requirements of the Los Angeles Fair Chance Initiative for Hiring ordinance.

It's time for a 'Space Transparency Act'

BY MORIBA JAH | moriba@utexas.edu

In my travels and conversations across the globe, a question has repeatedly come my way: "If you could be king for a day, what single change would you make related to space policy?" I always welcome this challenge, because it forces me to distill my vision into a single, actionable priority. My answer is simple but transformative: I would mandate that corporations and government agencies be transparent about the environmental and sustainability impacts of their space-based services.

For many, this may sound abstract or far-removed. Most people don't realize that outer space isn't some distant, irrelevant realm. It's figuratively in their pocket. Your smartphone — that lifeline of modern society — depends on satellites for GPS, weather data, communications and so much more. The truth is, space is all around us. It touches every part of our lives, even if we don't literally see it.

The irony is that while we know the environmental cost of tangible, earthbound industries, including manufacturing, automobile travel and air transportation, the impacts of space-based activities remain largely invisible. That needs to change. If I were king for a day, my decree would be that every satellite service provider do the equivalent of what airlines like United Airlines does now: Display carbon footprints in kilograms of CO2 for every itinerary. Imagine if every time you use your GPS, weather app or any satellite-reliant service, you could see its cost to our planet.

Here's why this really matters: The services we receive from satellites are not free; they come with a price that the Earth pays. Launching, operating and eventually deorbiting satellites requires resources and energy and contributes to environmental impacts like carbon emissions and atmospheric pollution. Because these costs are invisible to us as consumers, we have no say in the consequences. We, the people who rely on space services, lack agency because we are kept in the dark.

We live in a world that values choice and transparency. As I say, I can buy a plane ticket and see the carbon footprint of my flight. I can purchase sustainably sourced coffee or organic produce because information is provided about its impact. For a variety of reasons, I don't always choose the itinerary with the lowest impact to Earth or that sustainably sourced coffee, but that's a conscious decision. Let's have more of those.

Why shouldn't these same principles of transparency apply to space-based services? Why shouldn't we demand that companies offering these services reveal the environmental cost of

Moriba Jah is an astrodynamicist, space environmentalist and professor of aerospace engineering and engineering mechanics at the University of Texas at Austin. An AIAA fellow and MacArthur fellow, he's also chief scientist of startup Privateer.

their operations? This transparency would empower individuals, companies and governments to make informed choices based on the sustainability of the services they use. And if they don't, they know they aren't. It's about giving the public a seat at the table to help shape the future of space stewardship.

Currently, there are thousands of satellites in orbit, with tens of thousands more planned over the next decade. Every launch sends massive amounts of exhaust into Earth's atmosphere. Rockets burn fuels that can have significant effects on ozone depletion and climate systems. Meanwhile, Earth orbit is increasingly cluttered with dead satellites, abandoned rocket stages and fragments from collisions — debris that poses threats to operational satellites and even astronauts.

What's more, satellites have finite lifespans. Many are not responsibly deorbited and none are recycled, leaving their remains as junk in valuable orbital highways. This has created a sustainability crisis in space, one that mirrors the environmental crises here on Earth's surface. Just as we have become aware of deforestation, ocean plastics and fossil fuel emissions, we must now confront the fact that our activities in space have far-reaching impacts, both in orbit and on the surface of the planet we call home.

Transparency must also extend to the supply chains that make satellites possible. Satellites don't materialize out of thin air. They are built using materials sourced from mines, factories and suppliers across the globe. Yet, most of this supply chain remains hidden from the public. Where are these materials being sourced? How are they being extracted and processed? These are critical questions that demand answers because their environmental and societal costs are not only measurable but significant.

That said, I'm not advocating that companies disclose every proprietary detail of their supply chains. I understand the need to protect competitive information. However, I believe it's fair and necessary to demand basic transparency: What countries and regions do the raw materials come from? What are the sustainability and environmental impacts of those operations? Are these processes contributing to deforestation, human rights violations or pollution? These details matter.

By revealing this information, we can begin to hold companies and governments accountable for the full lifecycle of their products — not just their use in orbit but their origins here on the surface. If consumers knew the hidden costs of satellite manufacturing, they could push for better practices, cleaner technologies and more responsible sourcing.

Transparency is the first step toward accountability. By requiring satellite service providers to disclose their environmental impact, we would enable consumers to make informed choices. Do you want to use a navigation service from a provider whose satellite constellation produces high carbon emissions or one that prioritizes sustainability? Do you want your streaming services to come from companies that launch responsibly and invest in deorbiting technologies?

These decisions may seem small, but collectively, they send a powerful message: We value our only home, Earth, and we demand a future in which space activities are conducted responsibly.

Transparency will put pressure on companies to innovate and governments to incentivize them for this innovation. When faced with public scrutiny, businesses often develop cleaner technologies, smarter solutions and more sustainable operations. The result? A race to the top, where sustainability becomes a competitive advantage rather than an afterthought.

Just as there should be consequences for pouring chemicals into a pristine lake or cutting down an ancient forest, we should not allow space activities to proceed unchecked. Making satellite service providers accountable to the public is a necessary step toward ensuring that our use of space is sustainable and just. We must treat space as the shared resource it actually is: a commons that belongs to all of us.

The choices we make now will determine whether future generations inherit clean and safe orbits, a thriving planet and a space economy that works for all humanity. This vision starts with awareness. It starts with transparency. ★

Aerospace America publishes a rich variety of opinions relevant to the future of aerospace. The views expressed are those of the author(s) and do not necessarily reflect those of our publisher, AIAA.

LOOKING BACK

COMPILED BY FRANK H. WINTER and ROBERT VAN DER LINDEN

1925

Jan. 16 The National Aeronautic Association awards the 1924 Collier Trophy to the U.S. Army Air Service for completing the first flight around the world. The announcement describes the flight, completed between April and September by eight pilots in four Douglas Air Cruisers, as "the greatest achievement in aviation in America, the value of which had been thoroughly demonstrated during the previous year." **National Aeronautic Association Review, February 1925**, p. 29.

1 **Jan. 20-27** The USS Shenandoah airship makes a series of flights in conjunction with the U.S. Scouting Fleet, during which the Shenandoah moors several times to a newly installed mooring mast on the USS Patoka ship. This former replenishment oiler was converted into an airship tender specifically for the Shenandoah and subsequent airships that the Navy plans to acquire. **Aircraft Yearbook, 1926**, p. 117.

Jan. 24-25 Twenty-five aircraft, including the U.S. Navy's USS Los Angeles airship, take high-altitude photographs of a total solar eclipse. In the U.S., the path of totality begins in Oregon and stretches southeast toward South Carolina. Aviation, Feb. 2, 1925, p. 133; NASA, **Aeronautics and Astronautics, 1915-60**, p. 19.

Jan. 25 French aviator Charles Descamps breaks the 500-kilometer world speed record for airplanes carrying a load of 500 kilograms. He completes the circuit in 2 hours, 20 minutes, 48 seconds at an average speed of 213.053 kph (132.38 mph) in a De Monge M.101C2. The two-seater fighter is a license-built version of the Dutch Koolhovan FK.31. The record was formerly held by the American Louis Meister. **Aviation**, March 2, 1925. p. 244.

Jan. 26 British aviator Sir Alan Cobham pilots his de Havilland D.H.50 from Jalpaiguri, near Darjeeling, India, to Mount Everest, completing what is believed to be the first aerial survey of the world's highest mountain. His passenger, Sir Sefton Brancker, takes photographs from the open cockpit. The flight occurs as part of a larger expedition in which Cobham is attempting to identify possible air routes over the Himalayas from Britain to India. **Flight**, Feb. 5, 1925, p. 70.

1950

Jan. 3 U.S. Air Force Reserve Lt. Col. Jacqueline Cochran sets a Fédération Aéronautique Internationale speed record for a 500-km closed-circuit course. She pilots her piston-engine North American P-51 Mustang at a speed of 444 mph (714.549 kph). **Aircraft Yearbook, 1950**, p. 339.

Jan. 10 The research ship USS Norton Sound leaves Port Hueneme, California, for a 19-day cruise to test operational missiles in Alaskan waters. During the voyage, a variety of vehicles are launched from the ship, including two Aerobee sounding rockets, one Lark guided missile and one Loon test missile. **U.S. Naval Aviation, 1910-1970**, p. 181.

2 **Jan. 15** Retired Air Force Gen. Henry "Hap" Arnold, who led the Army Air Forces throughout World War II, dies at 63. One of America's earliest aviators, he flew with the Wright brothers and advocated for long-range airpower in the 1920s and 1930s. He won the Mackay Trophy in 1934 for leading a group of 10 Martin B-10 bombers on a 29,000-km round trip between Washington, D.C., and Alaska. In 1938, he succeeded Maj. Gen. Oscar Westover as chief of the U.S. Air Corps, a role he held until his retirement in 1946. Throughout his career, he supported aeronautical research, including the development of the turbojet engine and supersonic flight research, largely in conjunction with Theodore von Karman. **Aviation Week**, Jan. 23, 1950, pp. 14-15.

Jan. 19 British test pilot W.A. Waterton completes the inaugural flight of the first Canadian jet interceptor, the all-weather Avro Canada CF-100. The prototype is powered by two Rolls-Royce Avon jet engines, but those are replaced with a single Avro Orenda engine when the aircraft enters quantity production for the Royal Canadian Air Force as a single-seat fighter. The CF-100 reaches 650 mph and carries cannon and air-to-air unguided rockets. **The Aeroplane**, Jan. 27, 1950. p. 87.

Jan. 22 Stunt pilot Paul Mantz sets a transcontinental record for piston-engine aircraft. He flies the nearly 4,000 km from Burbank, California, to La Guardia Airport, New York, in 4 hours, 52 minutes, 58 seconds in a modified North American P-51 Mustang. **The Aircraft Yearbook, 1950**, p. 340.

3 **Jan. 24** North American Aviation pilot George Welch completes the first test flight of the YF-93A, a prototype of the F-93 long-range fighter. Initially designed as a new variant of the F-86 Sabre, the F-93 is later redesignated due to the large number of new features, including flush intakes derived from engine-inlet research conducted by NASA's predecessor, the National Advisory Committee for Aeronautics. Despite its better-than-predicted climb performance, only two YF-93s are acquired by NACA and flown as research aircraft. Norm Avery, **North American Aircraft, 1934-1998, Volume 1**, pp. 173-174.

1975

Jan. 9 NASA announces a Sea Satellite program to monitor the oceans and provide continuous weather and sea condition reports. Development of a proof-of-concept satellite, SEASAT-A, is to be managed by the Jet Propulsion Laboratory with several NASA centers overseeing different sensors on the satellite that are to "measure wave heights, current directions, surface wind directions, and surface temperatures." **NASA Release** 75-1.

Jan. 9 McDonnell Douglas Corp., under a NASA contract, begins flight and static tests of a modified JT8D engine to demonstrate noise-reduction techniques. Over two years at NASA's Lewis Research Center in Ohio, leading aircraft manufacturers and airlines companies replaced the engine's two-stage fan with a larger diameter single-stage fan and added materials in the engine and nacelle to absorb high-frequency noises produced during flight. When installed on a McDonnell DC-9, the new engine is expected to reduce noise by 60%, with similar results expected on Boeing 727s and 737s. **NASA Release** 75-4.

Jan. 11 The 38,000-kilogram Saturn V second stage that placed the Skylab 1 orbital workshop in orbit two years ago reenters over the Atlantic Ocean. NASA said that a large piece splashed down about 1,600 km west of Gibraltar, with smaller pieces scattered several kilometers to the northwest and southeast. Additional debris may also have fallen in the Sahara Desert, The Washington Post reports, "but NASA received no report that any fragments caused damage or injury." **Washington Post**, Jan. 12, 1975, p. A14.

Jan. 11 Soviet cosmonauts Aleksey Gubarev and Georgy Grechko are launched in their Soyuz 17 spacecraft from the Baikonur Cosmodrome. On the following day, they dock with the Salyut 4 space station. They spend nearly 30 days aboard, checking out the station in various flight conditions and studying solar phenomena and radiation. Other research activities include examining the effects of weightlessness on the human body and experiments with insects, microorganisms, tissue cultures and plants. **New York Times**, Jan. 16, 1975, p. 14.

4 **Jan. 13** U.S. Air Force Secretary John McLucas announces the selection of General Dynamics Corp.'s YF-16 prototype for development into the Air Force's next air combat fighter. The company receives a $417.9 million contract to deliver the first 15 aircraft. The first F-16 Fighting Falcon is delivered in 1979, and , 4,400-plus have been

built for the U.S. and several other countries. **Department of Defense Release** 16-75; **U.S. Air Force**, "F-116 Fact Sheet," Sept. 23, 2015.

Jan. 21 A new U.S. Department of Transportation report suggests that the current fleet of supersonic transports, as well as other high-altitude aircraft projected to enter service, will cause minimal damage to the ozone layer. Alan Grobecker, director of the department's Climatic Impact Assessment Program, describes the findings of the report, "The Effects of Stratospheric Pollution by Aircraft," in a press briefing. **New York Times**, Jan. 22, 1975, p. 33.

5 **Jan. 22** NASA launches Landsat 2, the second Earth-observing satellite developed under the program formerly known as ERTS, or Earth Resources Technology Satellite. Landsat 2 joins the Landsat 1 spacecraft, previously ERTS-1, to capture multispectral images over the U.S. and other countries to refine remote-sensing interpretative techniques and further demonstrate the practical application of Landsat data. The images from these satellites and subsequent ones in the Landsat series, jointly managed by NASA and the U.S. Geological Survey, comprise a data archive that NASA says "has vastly improved our understanding of the Earth, its natural resources, and its dynamic processes." Today, three Landsats are operational, with the next targeted for launch in late 2030. NASA, **Astronautics and Aeronautics, 1975**, p. 5; **NASA webpage**, "Landsat Science"; **NASA Releases** 74-329 and 75-31.

Jan. 23 The U.S. Air Force's B-1 prototype completes its second flight test. Among the primary objectives of the nearly 3.5-hour flight, from the Air Force Flight Test Center at Edwards, California, is to evaluate the strategic bomber's wing sweep control system. **AFSC News review**, March 1975.

Jan. 23 NASA's Marshall Space Flight Center breaks ground on a facility for testing X-ray telescope instruments for the High Energy Astronomy Observatory program. **Marshall Star**, Jan. 29, 1975, p. 4.

Jan. 27 NASA announces plans to launch materials-processing experiments aboard Black Brant VC sounding rockets, as a low-cost way of expanding observations made during the 1973-1974 missions to the Skylab space station. **NASA Release** 75-12.

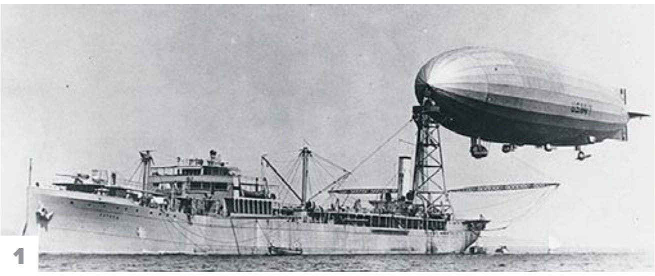
Jan. 27 U.S. Sen. Edward Kennedy, D-Mass., introduces a bill to authorize the secretary of the Interior Department "to acquire and maintain for future generations" the Auburn, Massachusetts, site where Robert Goddard launched the world's liquid-fuel rocket in 1926. NASA, **Astronautics and Aeronautics, 1975**, p. 12.

Jan. 31 NASA awards a $152.6 million contract to Martin Marietta Corp. to design, develop and test the space shuttle external tanks. These 47-meter-long orange tanks will hold the liquid hydrogen fuel and liquid oxygen oxidizer for powering the main engines of the shuttle orbiters. Along with being the largest section, the tanks are the only shuttle component not designed for reusability. **MSFC Release** 75-29.

2000

Jan. 18 Geoffrey Perry, a British physics teacher who in the 1960s established a radio interception school project that became a leading source on Soviet spy satellites, dies at 72. The data obtained by Perry's project, the Kettering Space Observer Group, was referenced by many government agencies during its 35 years. His work led to the West's discovery of Plesetsk, a secret military launch base. **Aviation Week**, Jan. 24, 2000, p. 21.

6 **Jan. 28** NASA releases the research results from STS-95, a 1998 space shuttle flight with John Glenn, the first American to orbit Earth, and six other astronauts. During their nine days in low-Earth orbit, 88 experiments were conducted, 10 with Glenn's participation. At age 77, he was the oldest person to travel to space. NASA, **Astronautics and Aeronautics: A Chronology, 1996-2000**, pp. 249-250.


1


2

3

4


5


6

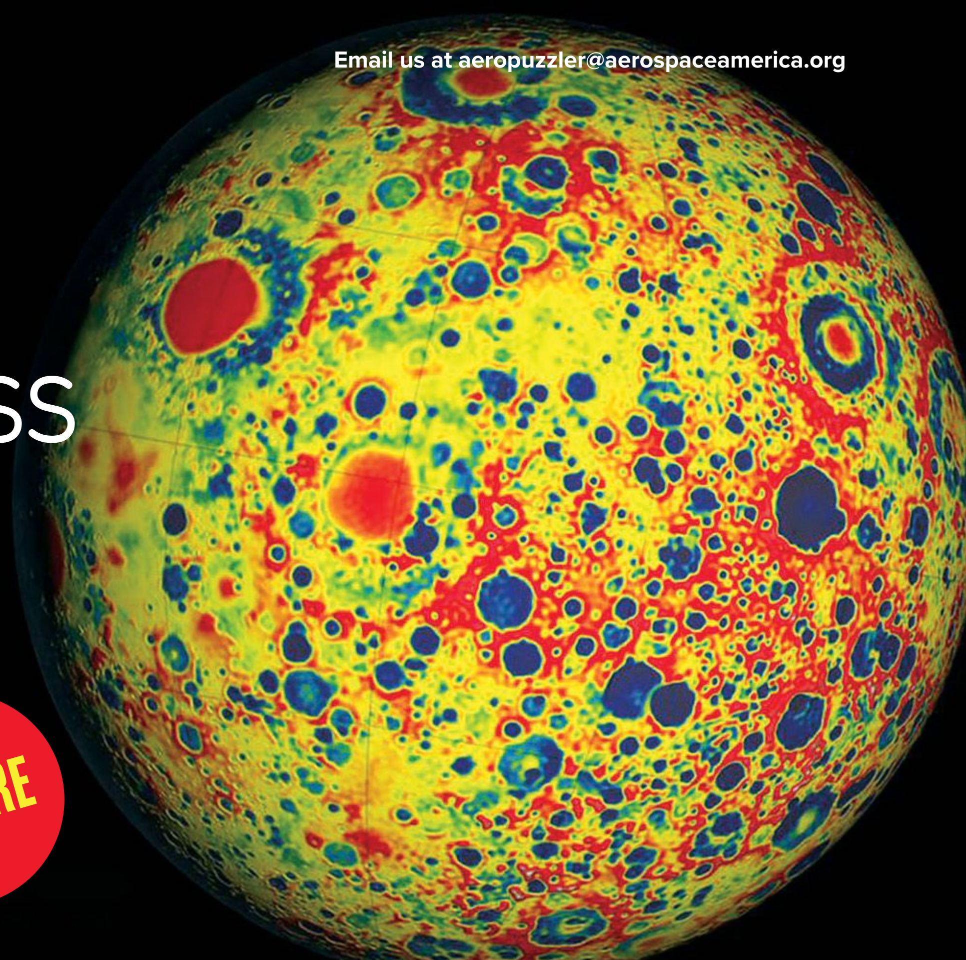
AERO PUZZLER

Email us at aeropuzzler@aerospaceamerica.org

Does mass matter to measure mass?

ENCORE

We ran this question in October 2023 and couldn't believe no one got it right. So let's try this again.



In this map of the moon created by measurements from NASA's Gravity Recovery and Interior Laboratory mission, red indicates areas with higher mass and blue indicates lower mass.

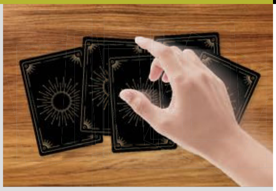
NASA/JPL-Caltech/MIT/GSFC

Q: The two spacecraft of the Gravity Recovery and Interior Laboratory mission were identical, according to NASA. They had to have the same mass to do their job of accurately measuring variations in lunar gravity. True or false, and why?

SEND A RESPONSE OF UP TO 250 WORDS
to aeropuzzler@aerospaceamerica.org. By responding, you are committing that the thoughts and words are your own and were not created with the aid of artificial intelligence. DEADLINE: noon Eastern Jan. 17.

Scan to get a head start on the next AeroPuzzler

FROM THE DECEMBER ISSUE



STEP RIGHT UP: We asked you to play a fictitious game that requires stringing together relevant words into a sentence and leaving out any extraneous words. We didn't receive any valid responses, so we asked John Hansen of Keysight Technologies to show us his answer. Words from the game are in red in his sentence below.

"Reynolds Number is the only phrase that would not fit in my sentence: Based on the ground-breaking work of 19th century Austrian mathematician Christian Doppler, we know that the frequency of an acoustic or electromagnetic wave shifts when a transmitter and receiver/reflector are in motion relative to other just as the frequency of the horn of a passing train shifts frequency, and this phenomenon can be tapped to find exoplanets through Doppler Spectroscopy or find objects in motion using Moving Target Indicator (MTI) radar."

TWO SIGNATURE EVENTS.
ONE EXPO HALL BRIMMING WITH INNOVATION.

CAESARS FORUM, LAS VEGAS

The global aviation and space communities are coming to Las Vegas for AIAA AVIATION Forum and ASCEND. These two events, co-located at Caesars Forum, embody groundbreaking innovation and offer unmatched technical prowess.

The Expo Hall will serve as a bridge between the two events and host 4,000+ attendees eager to see the latest technologies, products, and services on display, and the unique value that your organization brings.

EXPLORE EXHIBITING.

AIAA AVIATION Forum

aiaa.org/aviationsponsor

ASCEND

ascend.events/sponsor

AIAA