HORIZONS

National Aeronautics and Space Administration

NASA SETMO
SPACE ENVIRONMENTS TESTING MANAGEMENT OFFICE

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NEW AND NOTABLE

Congratulations to Dr. Joel Carney, who has been selected as the new Assistant Administrator for SETMO's parent organization, NASA's Office of Strategic Infrastructure. He is and will remain the chair of the SETMO Space Environments Testing Control Board.

Rigorous testing at NASA's Jet Propulsion Laboratory has led to a successful series of flights made by the Mars Helicopter Ingenuity, aka Ginny. Ginny is a technology demonstrator, a proof-of-concept vehicle providing new aerial perspectives on red-planet geology and views into areas too steep or slippery for a rover to operate without mishap.

One of NASA's major testing facilities, the Arc Jet Complex, stepped in to help in the aftermath of the SpaceX Demo-2 mission in May 2020. Post-reentry examination of the Dragon heat shield revealed unexpected erosion of one tension tie, a key mechanism that anchors the shield to the capsule, protecting the astronauts inside from extreme temperatures. Arc Jet studies led to additional tension-ties protections, paving the way for a worry-free SpaceX Crew-1 flight.

Electric propulsion is coming into its own, with testing occurring in chambers at NASA's Glenn Research Center. Advantages are enticing: among them, significant weight savings, more accommodating designs for crew and cargo, and increasing but smooth acceleration over time. Demand is driven by cost savings and flexible design options.

NASA's Space Environments Complex hosted a series of tests on the Orion space capsule that, as an essential constituent of the Artemis I mission, is scheduled to fly uncrewed around the Moon. The spacecraft was subjected to variations in extreme temperatures and electromagnetic fluctuations it must eventually endure. The Orion studies were originally slated to last for three months but were completed three weeks ahead of schedule.

FROM THE DIRECTOR

Welcome to Horizons, the first issue of the SETMO newsletter, where we'll be regularly capturing highlights of the great work done by our colleagues and at the facilities we're proud to support and sustain.

First and foremost, I want to commend and congratulate all those who continued their mission-critical testing work during the Covid-19 pandemic. Their commitment under very difficult circumstances is a tribute not just to expertise and adaptation, but also to dedication and determination. We as a nation and as a NASA organization have much to be grateful for because of those who stepped up and showed up. Their willingness to stay the course when the going was tough won't be forgotten.

Mission success has always been tied to the people and places that make possible rigorous testing of rockets, spacecraft and their constituent components in a variety of simulated atmospheres and extreme temperatures. Now more than ever, testing is critical to the challenges that await as we push out into deeper space, and expand human and robotic exploration throughout the solar system.

Whether it's to support an already scheduled or yet-to-be announced mission, NASA investment in testing enables development of next-generation technology and reduces risk for all present and future crewed missions. Technological innovations that result from testing allow us to bring life to new ideas, to make them viable and practical. Risk reduction enables missions to proceed confidently, keeping astronauts safe and their gear performing without a hitch each and every time it's used.

Anyone who watched a video of the first flight of the Mars helicopter Ingenuity — aka Ginny — on a planetary body dozens of millions of miles (and kilometers) from Earth wasn't just watching history being made, but the result of intense and sophisticated testing that directly led to a tough and resilient vehicle. We have a link in this issue to an article we published on Ginny's development and maturation, a process that made her literal otherworldly trip(s) possible.

We're likewise grateful for the talented Wei-yen Hu, SETMO's Chief Engineer, whom we profile in this edition of Horizons. Wei has a long and distinguished career, and he was thankfully willing to share his background and his perspectives on his years with NASA. We also take a deeper dive into one of NASA's most notable testing sites, the Arc Jet Complex, a one-of-a-kind facility at Ames Research Center in Mountain View, California. Research conducted there attests to its role as an invaluable national asset.

We're going to continue to add content to our website and are currently working on an overview video of the technical capabilities and the facilities we support. More issues of Horizons will follow. Here's hoping you enjoy this one, and those ahead. Don't hesitate to reach out to us with any comments or feedback.

Michael Mastaler

IN PROFILE

Wei-yen Hu | Chief Engineer

As a child, SETMO Chief Engineer Wei-yen Hu fancied himself at the controls of an airplane as it soared through bright blue skies. As an adult, Wei has journeyed far beyond youthful daydreams into studies of demanding testing environments and atmospheres that, although simulated, are far harsher than any terrestrial flights real or imagined.

"SETMO is really interesting. It's a lot like working on airplanes," he says. "It's a different challenge: You have to balance among the testing, the engineering and supporting a skilled workforce."

SETMO oversees a multi-billion-dollar portfolio of several dozen aerospace facilities, supervising assets that range over four distinct testing capabilities at nine NASA centers across the country. Coordinating with NASA headquarters offices and centers managers, SETMO provides funding and direction to optimize facility availability and performance, and also oversees infrastructure investments to enable state-of-the-art operations and maintenance, enhance reliability, and improve testing technologies.

Wei was born in Taiwan to parents who, having survived both World War II and a communist uprising, emigrated from the Chinese mainland. Wei's father was an economics professor and his mother, originally an agricultural products manager, would later become an accountant when the family relocated to the United States to live in New York City.

Part of Wei's childhood was spent in Taipei, Taiwan's capital city. It was an urban environment similar to that of New York. In America, the young Wei had to learn a vastly different language. "I slowly acclimated and adjusted," he said. "And the food was different."

A degree in aerospace engineering from the (then) Polytechnic Institute of New York would eventually follow, as did work as an intern for the U.S Army Corps of Engineers. That posting may have continued but for a hiring freeze, so Wei sent out about 200 resumes and one hit: the Facilities Engineering Division in Cleveland, Ohio at what is now NASA's Glenn Research Center. Wei would stay at Glenn for 17 years, in the process earning a master's degree in mechanical engineering.

When a subsequent opportunity presented, Wei relocated to NASA Headquarters, working in areas relating to operations and maintenance. Three years later, he joined the Strategic Capabilities Assets Program, or SCAP, SETMO's immediate predecessor.

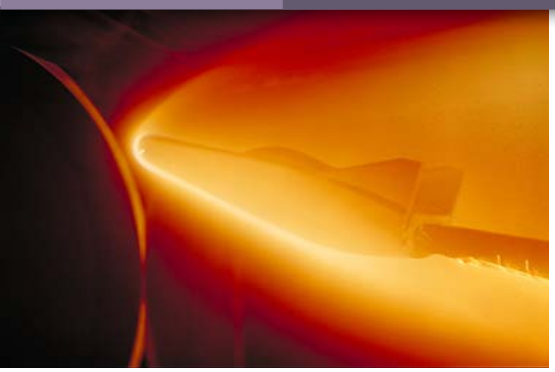
Wei finds his work with SETMO both challenging and satisfying, especially given the demands of balancing test-chamber readiness with facility sustainment and the need for mission-critical updates and improvements. "The equipment has to be ready to go," he says. "So the question really is how much and how long should we support these assets? It's a cost-benefit analysis."

Ultimately, Wei's professional satisfaction comes from both curiosity and challenge. In the latter case, there is always something new to learn and solutions to be found. And, of course, there is the pleasure of working with like-minded colleagues who share the same inclinations.

"Every time I think I know something, I find out there's another universe," he says. "There are many worlds out there and problems to work. They're all interesting and they're all hard. The fun part of this job is working with the people: everyone who works to keep things going. They're the unsung heroes."

IN FOCUS

Modernization Studies Heating Up at the Arc Jet Complex



This summer in the Northern Hemisphere may have been scorching, but it's nothing compared to the literally blistering environments that NASA's Arc Jet Complex (AJC) at Ames Research Center can mimic. Think a lightning-powered blow torch, says Don Nickison, SETMO deputy director, and you may get some idea of the extreme temperatures the AJC can marshal to assess the robustness of thermal-protection materials integral to rockets, spacecraft, and their components when exposed to severely intense heat.

"The Arc Jet Complex is unique in its capacity to conduct high-heat testing to simulate re-entry: conditions encountered by spacecraft coming back to Earth or landing on other planets," Nickison points out. "That's not easily reproduced, short of actually sending vehicles out to space and then monitoring what occurs when they return. The AJC is NASA's only large-scale ground-based facility that simulates those extreme-temperature regimes."

The Complex is one of SETMO's major affiliated facilities, with SETMO-overseen funding targeting critical upgrades and facility improvements. A series of AJC modernization studies are underway that aim to bolster the Arc Jet's capacity to support increasingly sophisticated 21st century testing. Earth reentries from future Moon and Mars flights beckon, as do other potential — and complex — missions, such as ones slated for Venus that will demand advanced thermal protection systems that NASA engineers are in the process of developing.

"For modernization, the challenge is to figure out how to appropriately invest in a facility that's worth about a billion dollars," Nickison says. "Think of a car: do you buy an entirely new one, or refurbish what you have? The Arc Jet is at a whole other scale, but some tough questions have to be answered, given that testing has to be more advanced for the next generation of space vehicles."

In the 1960s, the Ames complex was put to work to test Apollo-era spacecraft. Assessments in the 1970s of space-plane concepts would lead directly to the design and creation of the NASA space shuttle. Subsequent years and decades would be marked by ongoing evaluations of the designs and structures of human-carrying spacecraft and robotic exploration vehicles.

More recently, NASA's Orion spacecraft was put through extensive AJC testing in

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preparation for its first uncrewed, circumlunar flight — the Artemis 1 mission — that will occur to validate the craft's performance prior to a Moon mission carrying NASA astronauts planned sometime in the next several years.

Demonstrating the value of the AJC as it relates to commercial space, the Complex stepped to the fore in the aftermath of the SpaceX Demo-2 flight to the International Space Station in May 2020. After-mission inspection and close examination of the Dragon capsule's heat shield revealed unexpected erosion of one tension tie, a key mechanism that anchors the shield to the capsule, protecting the astronauts inside from the extreme temperatures experienced during reentry.

Follow-on Arc Jet tests led to improvements to, and additional protections of, the tension ties. A small area of the thermal protection system around the trunk attachments was refashioned. The modification was validated in conditions simulating both nominal flight and mission-abort scenarios, affirming the integrity of the Crew Dragon heat-shield design.

Initial AJC reliability and transformational improvements continue, including upgrades to systems controls and monitoring of electrical systems. Studies are also ongoing on how to create and integrate a new data acquisition system for the entire Complex, as well as extensive modernization options across entire facility.

"These efforts are going to play out over several years," Nickison says. "It's all about transforming the Arc Jet to meet the demands of the 21st century for the Agency by providing the best-value approach for improving and sustaining an available, and reliable, testing asset to meet the needs of NASA's exploration and science missions. That's the bottom line."

WHAT'S NEXT?

Prepping a Next-Gen Space Telescope

The premier orbital infrared observatory of the decade, NASA's James Webb Space Telescope remains on schedule for launch no earlier than October 31. Webb — tested extensively at both NASA's Goddard Space Flight Center and the NASA Glenn Space Environments Complex — will ship to the launch site in French Guiana in August, where final processing will take two months. The observatory has completed all post-environmental testing deployments, and is now in its integration and folding stages. Stow, closeout, and pack and ship are imminent.

The Artemis 1 Mission Takes Shape

Twin solid-rocket boosters for NASA's Space Launch System (SLS) rocket were mated atop the mobile launcher at the Agency's Kennedy Space Center in Florida as stacking and assembly activities for NASA's Artemis I mission continued. Crews from the spaceport's Exploration Ground Systems and contractor Jacobs teams lifted the 188,000-pound core stage and secured it to the solid boosters. A specialized crane was used to elevate, place, and secure the core stage on the mobile launcher inside the spaceport's iconic Vehicle Assembly Building.

Landing Systems for the Moon

The Human Landing System (HLS) is the final mode of transportation that will take astronauts to the lunar surface in the Artemis lunar exploration program. NASA experts will work closely with commercial partners to build the landing systems, leveraging decades of human spaceflight experience and the agility of the commercial sector to achieve a Moon landing sometime in the 2020s. Once one or more companies are selected, HLS concepts development and testing could begin at NASA simulator facilities.

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