National Aeronautics and Space Administration

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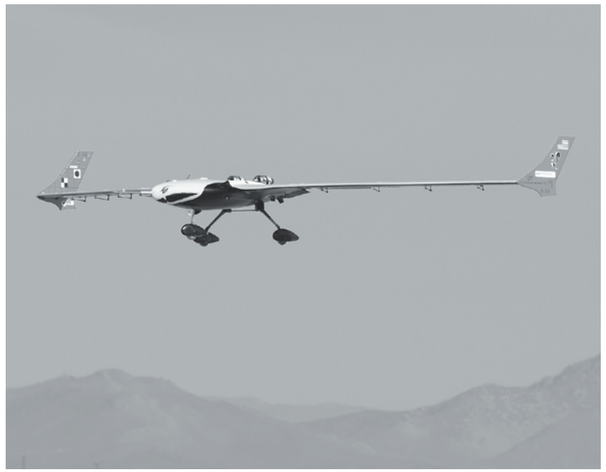
Second MUTT makes first flight

By Peter W. Merlin
NASA Armstrong Public Affairs

Researchers at NASA Armstrong successfully conducted the agency's first flight of the X-56A Multi-Utility Technology Testbed (MUTT) No. 2 on April 9.

The 20-minute flight marked the beginning of a research effort designed to yield significant advances in aeroservoelastic technology using a low-cost, modular, remotely piloted aerial vehicle. Aeroservoelasticity involves the interaction of an airplane's automatic flight controls with the response of non-rigid structures to aerodynamic forces. The X-56A is being flown in support of NASA's Advanced Air Transport Technology (AATT) project's Higher Aspect Ratio Wing subproject, Performance Adaptive Aeroelastic Wing element.

This was the first of eight planned Stiff Wing Controller Development envelope clearance flights. Successful efforts by the test team saw the X-56A attain an altitude of 4,000 feet above sea level and cleared for flight at up to 70 knots calibrated airspeed. Gary S. Martin, AATT associate project manager for integrated testing declared, "The flight went nearly exactly as rehearsed in the simulator."



ED15-0104-60 NASA/Ken Ulbrich

NASA researchers are using the X-56A, a low-cost, modular, remotely piloted aerial vehicle, to explore the behavior of lightweight, flexible aircraft structures.

The latest in a long series of experimental research aircraft, or X-planes, the X-56A was built by Lockheed Martin's Advanced Development Projects division in Palmdale, California, under a contract from the U.S. Air Force Research Laboratory (AFRL), Wright-Patterson Air Force Base, Ohio. Powered by twin 85-pound-thrust JetCat P-400 micro jet engines, the airplane has a semi-flying-wing configuration with winglets at the tips. Lockheed Martin constructed two airframe center-bodies along with several sets of wings because plans called for tests involving both stiff and flexible airfoils.

The maiden flight of the first airframe – nicknamed Fido – in June 2013, by Lockheed Martin and AFRL initiated testing to explore technologies for active flutter suppression and gust-

X-56A, page 12

Rocket validates sensor package

By Leslie Williams
NASA Armstrong acting news chief

Carnegie Mellon University (CMU) students developed a sensor package to analyze large pits in the surface of the moon or Mars that could lead to openings of caves. The package was launched recently on Masten Space Systems' XA-0.1B Xombie suborbital technology demonstration rocket during a NASA-sponsored launch and landing at the Mojave Air and Space Port in Mojave, California.

The computer vision technology sensor package was mounted on top of Masten's vertical-takeoff, vertical-landing Xombie. The rocket ascended to about 111 meters or nearly 365 feet, traversed over a simulated hexagon pit then returned to its pad. The total flight time was 64 seconds.

"We are working with Carnegie Mellon students who are developing a technology to build maps and 3-D models of the features of the moon," said Nathan O'Konek, Masten's director of business operations. "Our lander test vehicles are able to simulate landing trajectories that a lander on the moon would actually follow; we descend at rates similar to what a lunar lander would

Xombie, page 10

L.A. County Air Show rocks

ED15-0087-09 NASA/Ken Ulbrich

Martel Martinez greets visitors to the NASA exhibit.

ED15-0087-070 NASA/Ken Ulbrich

Attendees had a chance to see what they would look like in a NASA flight suit.

ED15-0087-177 NASA/Ken Ulbrich

The U.S. Air Force Thunderbirds amazed crowds with acrobatics and formation flying. About 60 staff and volunteers from NASA Armstrong participated in the NASA exhibit. More than 130,000 people attended the two-day event.

ED15-0087-062 NASA/Ken Ulbrich

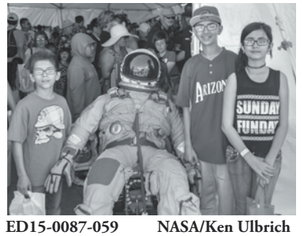
***Above**, flight test engineer Michelle Haupt signs an autograph.*

***At right**, a group of kids take a picture with a high altitude pressure suit.*

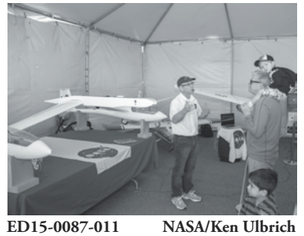
***At far right,** NASA Armstrong historian Christian Gelzer talks to people about remotely piloted aircraft at the center.*

ED15-0087-071 NASA/Ken Ulbrich

The NASA Armstrong F/A-18 was popular at the 2015 L.A. County Air Show.



ED15-0087-059 NASA/Ken Ulbrich



ED15-0087-011 NASA/Ken Ulbrich

Shin recognizes teams

By Jay Levine
X-Press editor

Jaiwon Shin, Aeronautics Research Mission Directorate associate administrator, recently presented an ARMD Associate Administrator's award and announced an honorable mention for two of NASA Armstrong's teams.

In the category of Program and Mission Support, the group award was presented to three NASA Armstrong members of the agency-wide Environmentally Responsible Aviation, or ERA, Project Control Team including Jennifer Hinckley, Rebecca Miani and Adam Rough.

The team was nominated for process controls and rigor that incorporated lessons learned from Phase I work and creating a suite of processes for tackling eight integrated technology demonstrations in Phase II. Those areas included risk and change management, full cost integrated master schedule, key decision point reviews, milestone completion documentation, integrated baseline reviews and interim tabletop walkthroughs. One process control feature called a "progress indicator" has since been replicated in all ARMD programs. Due to these practices, ERA completed all Phase I demonstrations and moved with confidence to Phase II work.

Miani is the resource analyst for most of the ARMD projects at NASA Armstrong. The award was specifically for her work on the Active Compliant Control Trailing Edge, or ACTE, project that is part of the ERA program.

Hinckley is the ACTE risk manager who assessed, managed and tracked all programmatic risks and monitored project risk progress. She facilitated meetings, documented programmatic and technical risks, managed mitigation efforts and developed briefing materials for key decision points and integrated baseline reviews. In the past Hinckley developed a NASA Armstrong risk management guideline document to assist project managers with a template when writing a risk management plan.

ED14-0369-01 **NASA/Ken Ulbrich**

ARMD Associate Administrator Jaiwon Shin, right, and NASA Armstrong Director David McBride, left, present an award to Rebecca Miani, second from left and Jennifer Hinckley, second from right.

Rough was the lead scheduler of the ACTE project portion of the full cost integrated master schedule. He helped develop the baseline project schedule and modified the schedule to keep crucial milestones on track. Rough also developed briefing materials for key decision points and integrated baseline reviews.

Honorable mention for teams in the same category of Program and Mission Support was the Alternative Fuel Effects on Contrails and Cruise Emissions II, or ACCESS II, NASA Social Team lead by Kate Squires. The advanced planning team from Armstrong included Gary S. Martin, Peter W. Merlin, Kevin J. Rohrer and Squires. Key advanced planning members also included Ruben Del Rosario from NASA Glenn Research Center in Cleveland, Bruce E. Anderson from the NASA Langley Research Center in Hampton, Virginia, and Karen Rugg from ARMD at NASA Headquarters in Washington, D.C.

The NASA ACCESS II team from NASA Armstrong included: Derek Abramson, Brian Beaton, Andrew D. Blua, Albion H. Bowers, Alan Brown (retired), Candance Clements, Brent R. Cobleigh, Greg Coggins, Frank W. Cutler, Christian Gelzer, Beth Hagenauer, Michelle Haupt, Darlene Homiak, Mary Ann Harness, Chris Jennison, Robert "Red" Jensen, Tom P. Jones, David Nils Larson, Jim "Clue" Less, Jay Levine, Kim L. Lewis-Bias and Steve L. Lighthill. In addition, the team included Lori A. Losey, Terri L. Lyon, Cam Martin, David D. McBride, Timothy R. Moes, Chris Naftel (retired), Jonathan B. Neuhaus, Steve S. Parcel, Joseph L. Piotrowski, Hernan D. Posada, Herman "Chico" Rijfkogel, James G. Sokolik, Brian D. Soukup, Edmund K. Swan, Thomas P. Tschida and John G. Zellmer.

The NASA ACCESS II team members also included NASA Glenn's Frances T. Jennings, NASA Langley's Katherine A. Barnstorff, Richard H. Moore, Gregory L. Slover and Richard J. Yasky, and from ARMD at NASA Headquarters, Jim Banke and Garvey Mcintosh.

News at NASA

Mercury mission a success

After extraordinary science findings and technological innovations, a NASA spacecraft launched in 2004 to study Mercury will impact the planet's surface, most likely on April 30, after it runs out of propellant.

NASA's Mercury Surface, Space Environment, Geochemistry, and Ranging (MESSENGER) spacecraft will impact the planet at more than 8,750 miles per hour (3.91 kilometers per second) on the side of the planet facing away from Earth.

On April 14, mission operators in mission control at the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Maryland, completed a series of orbit correction maneuvers designed to delay the spacecraft's impact into the surface of Mercury.

Although Mercury is one of Earth's nearest planetary neighbors, little was known about the planet prior to the MESSENGER mission.

The spacecraft traveled more than six and a half years before it was inserted into orbit around Mercury on March 18, 2011. The mission was to orbit the planet and collect data for a year. The spacecraft's healthy instruments, remaining fuel, and new questions raised by early findings resulted in two operations extensions. One key science finding in 2012 provided compelling support for the hypothesis that Mercury harbors abundant frozen water and other volatile materials in its permanently shadowed polar craters.

McMurtry fondly remembered

By Jay Levine
X-Press editor

Thomas C. McMurtry was respected by peers, admired for his piloting skills and appreciated for his mentoring by many who knew him. The retired NASA Armstrong research pilot died Jan. 3. He was 79.

He is known for his exploits behind the stick of such aircraft as the triple-sonic YF-12C, the U-2 and F-104 aircraft during a career that included more than 15,000 hours. This number includes 4,000 hours recorded while flying for two private aviation firms for 12 years after his retirement from NASA.

McMurtry joined the NASA Flight Research Center (now NASA Armstrong) in 1967 after service as a U.S. Navy pilot and as a consultant with the Lockheed Corporation. He was a project pilot on some of the most significant flight research projects in the center's history during his 32-year tenure, including the AD-1 oblique wing project, the F-15 Digital Electronic Engine Control project, the KC-135 winglets study and the F-8 Supercritical Wing project for which he received NASA's Exceptional Service Medal.

He also served as co-project pilot on a number of other flight research projects, including the F-8 Digital Fly-By-Wire project and the X-24B lifting body. McMurtry also flew one of the two modified NASA 747 Shuttle Carrier Aircraft, or SCA, that ferried space shuttles from Edwards Air Force Base, California, to Kennedy Space Center in Florida.

Bill Brockett, a longtime NASA pilot, flew missions of the Kuiper Airborne Observatory, the precursor to the Stratospheric Observatory for Infrared Astronomy, with McMurtry at the NASA Ames Research Center in Moffett Field, California. Brockett also came to NASA Dryden (now Armstrong) as a result of McMurtry's prompting.

"It's difficult to think about him without going to superlatives," Brockett said. " He was one-of-a kind, polite and well spoken. He was rock solid and steady as anybody I ever met. The first thing that struck me was his big smile and how all the young Air Force guys marveled at meeting him. "

EC77-8142 **NASA**

The flight crews of the space shuttle prototype Enterprise and the NASA 747 Shuttle Carrier Aircraft included, from left, Fitz Fulton, Gordon Fullerton, Vic Horton, Fred Haise, Vincent Alvarez and Tom McMurtry.

ECN-3442 **NASA**

Project pilot Tom McMurtry is pictured on the ramp with the TF-8A Crusader Supercritical Wing research vehicle. McMurtry received NASA's Exceptional Service Medal for his work piloting the aircraft.

When Brockett was going to retire from NASA in the late 1990s, McMurtry factored into the decision.

"I was going to retire from NASA and go back to industry to become an airline pilot," Brockett said. "Six weeks before retirement I received an e-mail from Tom and an offer to assist me with references. I responded that I really enjoyed working with him and only regret never having taken him up on an offer to go on an F/A-18 ride."

A week before he retired, McMurtry asked former NASA astronaut and then Dryden pilot Gordon Fullerton to fulfill Brockett's request. A flight with Gordo was enough to change Brockett's mind.

"By the end of the flight I realized that I really wanted to stay with NASA and not go back to airline flying. I went in an entirely different direction because McMurtry completely changed my mind.

"I view him as a father figure and a symbol of the right way to live your life. He exemplified all of the finest values of honesty and integrity and properness and cheerfulness."

Brockett also recounted a McMurtry F-104N flight that didn't go as planned.

"McMurtry in an F-104 chased the NASA B-52 that was to drop Bill Dana in the M2-F3 lifting body aircraft during a test mission over the lakebed," Brockett recalled a story McMurtry told him, "He was to fly safety chase. The F-104 was close to stalling to stay slow enough to remain behind the lifting body and monitor flight control positions. About the time of release of the lifting body, McMurtry stalled and the aircraft went into a spin.

"The lifting body was flying, but everyone was riveted on the F-104 in a spin. The aircraft were notoriously hard to pull out. He had tried three recovery attempts. Then he tried once more and this time the aircraft's nose dropped low enough that the F-104 came out of the spin right in position at the wing of the lifting body and flew through the mission as if nothing had happened. McMurtry said, 'It would have been really embarrassing if I had to eject on a chase flight.'"

Bradley Flick, NASA Armstrong director for Research and Engineering, recalled working for McMurtry as a young operations engineer.

"While Tom was not formally a mentor to me, I enjoyed a very good, open relationship with him

McMurtry, page 11

‘Dean of Flight Test’ dies at 89

By Peter W. Merlin
NASA Armstrong Public Affairs

Distinguished former NASA research pilot Fitzhugh L. Fulton Jr., described by colleagues as “The Dean of Flight Test,” died Feb. 4. He was 89.

During a career in the military, civil service and industry, he logged over 16,000 flying hours in more than 240 types of aircraft from the triple-sonic, titanium and composite SR-71 to the corrugated tin, prop-driven Ford Tri-Motor. He piloted airplanes of all sizes, from the diminutive Cessna 210 to the behemoth C-5A. Fulton retired from NASA in 1986 after 20 years at the agency’s Flight Research Center (now Armstrong) and 23 years of Air Force service that included support of the Operation Crossroads atomic bomb tests in 1946 and more than 200 missions during the Berlin Airlift in 1948 and 1949.

Following combat service in Korea and a 14-year assignment as an Air Force test pilot at Edwards Air Force Base, Fulton joined NASA on Aug. 1, 1966. Over the next two decades he flew more than 60 different types of aircraft from sailplanes and helicopters to high-performance supersonic jet fighters and bombers. He piloted some of the world’s fastest jet planes including the XB-70 and YF-12, each capable of speeds in excess of 2,000 mph and altitudes above 70,000 feet.

Former NASA Dryden pilot Don Mallick first met Fulton when he was an observer from NASA Langley Research Center in Hampton, Virginia. Mallick saw first hand Fulton’s skill on a Dryden sonic boom project with the B-58.

“I was very impressed with his preparation in tech and crew briefings and especially with the way Fitz flew the B-58 missions in such a precise manner,” Mallick said.

As Mallick’s instructor pilot, they flew together in the TB-58 and B-52.

EC72-2977 **NASA**

Fulton piloted the triple-sonic YF-12A for high-speed, high-altitude research missions in a joint program with the Air Force from 1969 to 1979.

EC80-13307 **NASA**

In 1980 Fulton flew the AD-1, a research aircraft designed to investigate the concept of an oblique (or pivoting) wing.

“The experience of flying with Fitz was a great one. He was an outstanding flier, both in physical control of the aircraft and the headwork in flying,” Mallick said. “I can say without question that he was the smoothest, most proficient aviator that I have ever had the experience of flying with . He is sorely missed, but will never be forgotten.”

Johnny Armstrong, who includes in his accomplishments flight planning for the X-15, the X-24A and X-24B lifting body aircraft and was a member of the U.S. Department of Defense team that evaluated the space shuttles, also had his first experiences with Fulton on the B-58.

“In October 1957 I had my first YB-58 flight with Maj. Fitz Fulton. In addition to the thrills associated with flying to Mach 2, Fitz developed my confidence and cared like a father. It was a special relationship that continued throughout his life. He always said the B-58 was his favorite airplane. His small pickup truck license plate said, YB-58,” Armstrong said.

Fulton was project pilot on the NB-52B mothership that launched the rocket-powered X-15 research aircraft, wingless lifting bodies and a variety of remotely piloted vehicles. While in the Air Force he had also flown the B-29 and B-50 motherships used to air-launch the X-1 and X-2 rocket planes.

He was the pilot of the Boeing 747 Shuttle Carrier Aircraft (SCA) on all captive and free-flight tests of the Enterprise in the 1977 Approach and Landing Test series. Fulton was twice awarded NASA’s Exceptional Service Medal for flying the SCA, which he also piloted during ferry missions to return operational orbiters to Kennedy Space Center, Florida, following their return from space.

Fulton repeatedly demonstrated his piloting skills.

“My admiration for Fitz’s flying skills continued through the X-15 program when he was pilot of the B-52 mothership and I was in the control room guiding him to the critical launch point for launch of the X-15,” Armstrong said.

His admiration only grew during the Approach and Landing Tests with a NASA B-52 and the Space Shuttle Enterprise prototype.

“He also became a hero to many when he flew the risky first flight of the 747 with the space shuttle mounted on top,” Armstrong said. “I recall being in a meeting when Paul Bikle was director about the risk associated with the concept long before the decision was made to fly it. When asked if he would fly in such a test, Fitz responded, ‘I will not fly in it, but I will fly it.’ I already miss my friend and hero.”

Fulton served as project pilot on a specially modified C-140 JetStar for the Laminar Flow Control

Fulton, page 11

X-Press April 2015

SALUTE highlights Armstrong work, capabilities

By Jay Levine
X-Press Editor

Edwards Air Force Base community members and local school students were invited to learn more about what Armstrong employees do and the center's capabilities at a March 2 event.

The event was called the Science and Aerospace Leaders United as Team Edwards, or SALUTE. A diverse set of 15 presentations and 70 exhibits showcased nearly every area of the center for the more than 1,400 attendees and Armstrong employees.

"Hopefully we will see even more communication and efficiencies develop between the Air Force and NASA," said Zachary Wright, one of the coordinators. "Feedback from the schools was overwhelmingly positive. In addition, we believe there will be a lasting impact from the SALUTE event, especially from the NASA relationships that were developed as everyone came together to make the event a success."

Alexander Chin, Brittany Martin and Wright first conceived the SALUTE idea more than a year ago. They were 2014 classmates in the Foundations of Influence, Relationships, Success, and Teamwork, or FIRST program. FIRST is a NASA early career leadership development program that requires a center-oriented project. The idea of adding a science, technology, engineering and math, or STEM, element for the schools seemed a natural fit as the idea blossomed.

"One major objective of the project was to increase community awareness of NASA Armstrong's missions and contributions," Chin said. "Most military personnel are only stationed at Edwards for a few years. It is unfortunate that many of them do not usually have a chance to visit NASA Armstrong to see all of the work we do. The SALUTE event was a great way to increase the visibility of the center by inviting our U.S. Air Force colleagues to visit."

ED15-0061-125 NASA/Tom Tschida

SALUTE event attendees were able to see a ER-2 fly in the skies overhead.

ED15-0061-020 NASA/Tom Tschida

Eighth grader Moon Gonzales tests a wind turbine design at the SALUTE event.

ED15-0061-073 NASA/Tom Tschida

Ethan Baumann answers students' questions about careers in aeronautics.

Seeing workers who are employed in a wide spectrum of careers was a boost to many students who were unaware of the diverse mix of jobs at NASA.

"You don't have to be a rocket scientist to work at NASA," Martin said. "We have a lot of scientists and people who are excellent at solving equations, but there are skills in other areas that also contribute to the center's work. Some skills are aimed at translating what 'nerds' talk about into language, graphics and images that the rest of the world understands and thinks are cool."

ED15-0061-156 NASA/Tom Tschida

Patrick Chan explains a feature of the Ikhana to U.S. Air Force Test Center Commander Maj. Gen. Arnold Bunch Jr.

ED15-0061-109 NASA/Tom Tschida

Jennifer Cole shows SALUTE event visitors the uses of a water tunnel.

ED15-0061-057 NASA/Tom Tschida

Sixth grader Skye White holds a shape memory alloy bar as Matt Moholt applies hot air to straighten it out.

In one case, the organizers were asked about the possibility of another tour.

"One principal said the tour of the Armstrong fabrication branch and machine shops showed students that kind of work can be more than just a hobby," Martin said. "He wanted to know if it was possible to coordinate a tour more focused on those areas. We are looking into that possibility."

Armstrong employees were a focus.

"It also was one of our goals to give Armstrong employees an opportunity to see what other areas are doing," she said.

Each center organization also had an integral role in touting the center's missions, capabilities and people, Wright added.

"Armstrong employees were excited and came up and said, 'Hey, that was awesome. We really enjoyed it,'" he said.

For Armstrong presenters, the SALUTE also offered an opportunity.

"People are excited about what they do, they just needed a chance to show it off," Martin said.

ED15-0061-101 NASA/Tom Tschida

ED15-0061-106 NASA/Tom Tschida

***Above**, Carl Magnusson and Trevor Haupt, from left, talk about the DC-8 aircraft.*

***At left**, Jason Nelson explains that the Onsrud Five Axis Router is used for cutting out molds for composite layout.*

Out of this world certification

By Leslie Williams
NASA Armstrong acting news chief

A Lunar and Meteorite Disk Certification educator workshop was held at the NASA Armstrong Office of Education's Resource Center located at the Aerospace Education Research and Operations, or AERO, Institute in Palmdale on Feb. 21.

Twenty-seven regional teachers and one from New York participated in a professional development workshop that was presented by education specialist Barbara Buckner, subject matter expert Peter Merlin and education resource center manager Sondra Geddes.

Having a Lunar and Meteorite Disk Certification permits educators to submit a request to borrow the lunar or meteorite disk for use in their classroom. Equipped with guides and workshop knowledge, teachers can share these small portions of extraterrestrial materials with their students to learn more about the moon and meteorites.

"I am excited to show my students that the elements we study in class are throughout the universe and here are actual fragments of extraterrestrial rocks with the same elements," said Joe Vanasco from Walter O'Connell High School. "Then we can explore percent composition and compare that to earth rocks."

ED15-0049-069 **NASA/Ken Ulbrich**

Teachers learn about a volcanism activity known as lava layering using baking soda and vinegar to simulate a volcanic eruption.

The workshop featured lunar disks with moon rock and soil samples brought back from the historic Apollo missions encapsulated in clear Lucite. During the workshop, teachers engaged in hands-on, standards-based activities for learning about accretion, differentiation, cratering and volcanism.

"Even though the purpose of the workshop was the certification for lunar rocks and meteorites, the workshop provided activities that are relevant to sixth-grade science," said Geoffrey Langbehn, Summerwind Elementary School. "Specifically, the lava layering activity fits nicely with 'Shaping Earth's Surface' in the sixth-grade science curriculum as does the impact craters activity. I look forward to implementing both with my students."

Peter Merlin, a former NASA historian and current strategic communications specialist explained the various types of meteorites and their origin and shared his personal meteorite collection including specimens of the recent Chelyabinsk meteorite impact in Russia. He also discussed the Rosetta mission to orbit and land on a comet.

Armstrong researchers publish work

NASA Armstrong research resulted in nine articles and technical publications and recognition.

January

Albion H. Bowers, Oscar J. Murillo Jr., Robert "Red" Jensen, Brian Eslinger and Christian Gelzer collaborated on, "Spanload Implications for the Flight of Birds," a journal article prepared for the consideration of the editorial board of the journal "PLOS ONE," @ Public Library of Science, ISSN 1932-6203.

Alexander W. Chin, Claudia Y. Herrera, Natalie D. Spivey, William A. Fladung and David Cloutier co-authored, "Experimental Validation of the Dynamic Inertia Measurement Method to find the Mass Properties of an Iron Bird Test Article," AIAA-2015-2060, presented at the 56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Kissimmee, Florida, January 5-9, 2015.

Curtis E. Hanson, Christopher J. Miller, John H. Wall, Tannen S. Vanzwieten, Eric T. Gilligan and Jeb Stuart Orr collaborated on, "Launch Vehicle Manual Steering with Adaptive Augmenting Control: In-Flight Evaluations of Adverse Interactions using a Piloted Aircraft," AIAA-2015-1776, presented at AIAA SciTech 2015, Kissimmee, Florida, January 5-9, 2015.

William A. Lokos, Eric J. Miller, Larry D. Hudson, Andrew C. Holguin, David C. Neufeld, and Ronnie Haraguchi co-authored, "Strain Gage Loads Calibration Testing With Airbag Support for the Gulfstream III Subsonic Research Aircraft Testbed," AIAA-2015-2020, presented at the AIAA SciTech 2015 conference, Kissimmee, Florida, January 5-9, 2015.

Chan-gi Pak presented his paper, "Wing Shape Sensing from Measured Strain," AIAA-2015-1427, at the 56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, January 5-9, 2015, Kissimmee, Florida.

Chan-gi Pak wrote, "Wing Shape Sensing from Measured Strain," NASA/TM-2015-218358.

Peter M. Suh, Howard J. Conyers, and Dimitri N. Mavris, "Rapid State Space Modeling Tool for Rectangular Wing Aeroservoelastic Studies," AIAA-2015-1135, presented at SciTech 2015, Kissimmee, Florida, January 5-9, 2015.

William Ko and Van Fleischer had their article entitled, "Half-Cycle Crack Growth" appear in the January 2015 edition of the NASA Tech Briefs magazine.

At the AIAA SciTech 2015 conference in Kissimmee, Florida two NASA Armstrong researchers were recognized with a Certificate of Merit for Best Papers in the Atmospheric Flight Mechanics Best Paper category.

Peter Suh and Alexander Chin of NASA Armstrong and Dimitri N. Mavris of the Georgia Institute

Research, page 12

SAA system demonstration is a success

By Peter W. Merlin
NASA Armstrong Public Affairs

NASA, the Federal Aviation Administration (FAA), General Atomics Aeronautical Systems (GA-ASI) and Honeywell International Inc. have successfully demonstrated a proof-of-concept sense-and-avoid (SAA) system, marking a major milestone to inform the development of standards and regulations to safely integrate Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS). The results of this demonstration will aid in the development of the FAA's Airborne Collision Avoidance System For Unmanned Aircraft (ACAS Xu) and contribute to the broader UAS community.

According to UAS-NAS project manager Laurie Grindle, "Our team is working toward solving our common goal of overcoming the challenges of integrating UAS into the National Airspace System; a topic that has increasingly proved its relevance as several industries across the country identify the need to fly UAS. Completing these recent flight tests has brought us one more step toward accomplishing that goal."

GA-ASI worked with NASA Armstrong to integrate the new system aboard NASA's Ikhana research aircraft, a civilian version of the company's Predator B. The flight-test campaign in November and December 2014 evaluated the SAA system in a wide variety of collision-avoidance and self-separation encounters between two remotely piloted aircraft and various manned aircraft and included a sensor fusion algorithm being developed by Honeywell.

ED14-0341-44 NASA/Carla Thomas

NASA is using the remotely piloted Ikhana in the UAS-NAS project, an important research effort for improving safety and reducing technical barriers and operational challenges associated with flying unmanned aircraft in airspace shared by commercial and civil air traffic.

"GA-ASI is proud to continue development of SAA technology with NASA, the FAA, and our industry partners," said Frank Pace, president, Aircraft Systems, GA-ASI. "This public-private collaboration has achieved an important step for the safe and efficient integration of UAS into

System, page 12

ER-2 completes satellite validation flight series

By Kate Squires
NASA Armstrong Public Affairs

NASA's high-altitude ER-2 aircraft completed a series of validation flights last month in support of the Earth-observing NASA/NOAA Suomi National Polar-orbiting Partnership satellite, or Suomi NPP. The campaign was jointly sponsored by NASA and NOAA and based out of Keflavik, Iceland, conducting science flights from March 7 to 31, 2015.

NASA/Brian Hobbs

The ER-2 crew makes adjustments in Keflavik, Iceland, as the pilot and aircraft prepare for take off.

The mission primarily addressed characterizing Suomi NPP's Cross-track Infrared Sounder (CrIS), Aqua's Atmospheric Infrared Sounder (AIRS), and the MetOp-A and MetOp-B Infrared Atmospheric Sounding Interferometer (IASI) instruments' absolute and relative performance in observing extremely cold scenes. The mission also sought to improve geophysical parameter retrieval performance for such challenging polar atmospheres as well as provide anchor points for future numerical weather prediction (NWP) data assimilation studies using satellite data.

ER-2 calibration flights were timed to fly directly under the path of Suomi NPP. These same aircraft flight profiles were defined to also obtain simultaneous aircraft measurements parallel with the NASA Aqua satellite, which gathers information about Earth's water cycle, and MetOp-A and MetOp-B, two polar-orbiting satellites operated by European Organization for the Exploitation of Meteorological Satellites. The flight profiles not only enable validation but also cross-validation among the platforms.

Information from these flights is used to establish the accuracy of Suomi NPP's measurements. The study also provides comparisons of the information from other satellites to verify the overall accuracy for a multitude of observations ultimately benefiting end-user applications, including those related to weather forecasting and climate models. This information also provides a wealth of input in support of other future scientific studies.

NASA's ER-2 aircraft operates at approximately 70,000 feet, flying above most of the Earth's atmosphere that enables a measurement perspective closest to that seen by overhead satellites, a critical element in satellite sensor validation.

The remote sensing instruments that were flown aboard the ER-2 were all operated by NASA Ames Research Center in Moffett Field, California.

The ER-2 is one of a fleet of modified aircraft that support NASA's Airborne Science Program under the Science Mission Directorate and is based at NASA's Armstrong Flight Research Center's Building 703 in Palmdale, California.

The Suomi NPP mission is a bridge between NASA's legacy Earth-observing missions and NOAA's next-generation Joint Polar Satellite System. Suomi NPP, NOAA's primary polar orbiting weather satellite, carries groundbreaking new Earth-observing instruments that will fly on the other satellites in the JPSS constellation.

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load alleviation for new kinds of lightweight, flexible aircraft. The second airframe – dubbed Buckeye – arrived at Armstrong on June 2, 2014. Three low-speed taxi tests were conducted in January 2015 and a medium-speed taxi test was accomplished in March. Buckeye's initial flights will allow researchers to checkout aircraft systems, evaluate handling qualities, characterize and expand the airplane's performance envelope, and verify preflight predictions regarding aircraft behavior. The results will inform planning for the next phase of testing.

Leveraging the AFRL-sponsored program affords NASA with a unique opportunity to obtain significant expertise in modeling, analysis, and control of real-world aeroservoelastic challenges. The agency's effort includes participants from several NASA centers; engineers at Langley Research Center in Hampton, Virginia, and Glenn Research Center in Cleveland, Ohio, are involved with modeling and analysis while Armstrong and AFRL are responsible for flight-testing. Lockheed Martin also provides vital assistance and support.

Researchers believe the next generation of aerospace vehicles will pose serious challenges to designers' ability to model, predict, and control potentially destructive aeroservoelastic dynamics and to exploit efficiency gains from lighter, more flexible structures. The use of real world flight systems such as the X-56A MUTT will impart unique knowledge and expertise that will benefit the development of such vehicles across all speed regimes.

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civilian airspace by leveraging NASA's unique test capabilities and the FAA's novel collision avoidance technology."

Initial SAA flight tests successfully demonstrated both the automatic collision avoidance system as well as pilot-in-the-loop self-separation functionality for UAS. Over the course of five weeks, nine flights were conducted. The team flew 170 encounters and collected over 50 hours of flight data with notable accomplishments. These flight tests marked the first time that a UAS collision avoidance system was tested without artificial horizontal and vertical offsets applied to the algorithm as the air-to-air encounters were flown in actual conflict conditions. These flights were also the first time that a coordinated automatic response was employed by a UAS to resolve collision avoidance conflicts. In addition, tests involving Armstrong's Ikhana and a GA-ASI owned Predator B marked the first air-to-air collision avoidance encounters between two UAS.

Objectives of this effort included evaluation of the performance of ACAS Xu collision avoidance algorithms against air traffic using both legacy Traffic Collision Avoidance System (TCAS II) messages and proof of concept Automatic Dependent Surveillance-Broadcast (ADS-B) messages. For these tests, air traffic designated as a non-cooperative intruder was tracked using an air-to-air radar system developed by GA-ASI. ACAS Xu is the first collision avoidance function designed explicitly for UAS. It can be matched to aircraft performance and is designed to be fully interoperable with future ACAS X variants as well as with legacy systems such as the TCAS II currently used on most commercial transport aircraft.

Researchers evaluated three self-separation displays and algorithms and their ability to effectively inform the UAS pilot of nearby traffic and help resolve conflicts in a timely manner. These flight tests also validated airborne radar and ADS-B surveillance simulation models on sensor performance and uncertainties to help determine the effects of these parameters and environmental conditions on self-separation algorithm's performance. Flight-testing of collision-avoidance and self-separation technology contributes to ongoing work to develop a technical standard for a sense/detect-and-avoid system for UAS.

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