National Aeronautics and Space Administration

The Dryden X-PRESS

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Collision avoidance system works

By Gray Creech
Dryden Public Affairs

Dryden project officials are hailing the success of recent flight tests of a miniature automatic ground collision avoidance system, or Auto-GCAS, for small, unmanned aircraft. The smartphone-assisted system repeatedly executed pull-ups or sharp upward turns of the test aircraft to avoid imminent impact with terrain in its flight path.

During final test flights of the software integrated into an autopilot on the Dryden Remotely Operated Integrated Drone, or DROID, research aircraft in May, the system consistently commanded evasive maneuvers when it sensed the aircraft was getting too close to rocky, mountainous terrain or ridgelines.

The software has been adapted by the project team into an application for a smartphone using the Android operating system linked to a small Piccolo autopilot. The last flight tests were flown with the smartphone containing the developmental software installed in the aircraft.

"For these last flights, the smartphone aboard the aircraft eliminated the need for the ground control station link to be in constant communications with the aircraft," said Dryden's project manager Mark Skoog. "On these flights the system performed very reliably, consistently initiating recoveries close to the last possible moment, even in the face of numerous losses of communications with the ground control station right at the critical point of needing to avoid colliding with the mountain."

The last two flights, conducted at a remote dry lake surrounded by hilly desert terrain northeast of Edwards Air Force Base, saw the system successfully execute five mountainous terrain collision avoidance fly-ups, five ridge crossings executed with and without the software's multi-trajectory mode on, and a clockwise and counter-clockwise patrol over the valley with the multi-trajectory mode off.

The last flights were not without a few glitches that are often the hallmark of experimental flight testing and software development, ranging from computer cooling issues in the ground control station van, to a non-responsive left actuator on the DROID research aircraft. The latter challenge forced the project team to disassemble the aircraft's wing, where they discovered wires had separated. Innovative repairs were made in the field requiring a creative use of the minimal resources available, and the aircraft was again ready to fly.

Test objectives of the final flights included phone-on-aircraft testing of the team's latest software changes for failure mode logic of the collision avoidance system. The project team also collected terrain influences on wind for

See DROID, page 8

ED12 072-093 NASA photo by Tom Tschida

ED12 0172-12 NASA photo by Tom Tschida

***Above**, banking hard after a very close pass near a ridgeline, the DROID research aircraft provided good data for project engineers during flight tests of a miniature ground collision avoidance system for small, unmanned air vehicles.*

***At left,** DROID project team members secure the aircraft's single-piece wing after a successful flight.*

Applying what they've learned

Students chosen for work experience programs

If it seems like there are a lot of new faces at Dryden this month, it's because there are. About 90 students in 11 programs are gaining valuable work experience this summer while learning to apply the theories to the practice of their specialties. Students are listed under the program in which they participated.

• The Achieving Competence in Computing, Engineering and Space Science, or ACCESS, program is designed for undergraduate and graduate students with disabilities who have strong backgrounds in science and are pursuing technical careers. William Martin represents the program at Dryden this summer.

• The Aeronautics Academy offers college students opportunities for intense training in aeronautics that includes research, leadership development, and broad exposure to the nation's aeronautics enterprise. Eight students are participating in this program including Luis Andrade, Kimberly Callan, Javier Gonzales-Rocha, Julianna Plumb, Stephanie Reynolds, Ronalynn Ramos, Steffi Valkov and Joseph Wagster.

• The Aerospace Education Research and Operations, or AERO, Institute awards internships to students for work assignments at Dryden that are made based on the needs of the center's branches or requirements of award funding sources, such as the Aeronautics Research Mission Directorate at NASA Headquarters. AERO Associates are those chosen for specific jobs, while AERO Scholars are students participating in work assignments as part of a scholarship they have been awarded.

This year's AERO Associates include Maria Blue, Leo Banuelos, David Brunell, Alexander Cleveland, Elina Cruz, Braxton Cullors, Erika Fedorko, Hector Gutierrez, Julie Labadie, Michael Luong, Anthony

See Students, page 6

ED12 0256-40 **NASA photo by Tom Tschida**

Students who arrived in early June to participate in student programs included, front row from left, Julianna Plumb, Stephanie Reynolds, Courtney Marietta, Melissa Barnett, Erika Fedorko, Elina Cruz, Gregory Morales, Ronalynn Ramos, Cheyenne Bolanos, Christopher Ramirez, Alexander Cleveland, Derrik Yabut and Jessica Alvarenga. In the back row, from left, are Javier Gonzales-Rocha, Sanel Horozovic, William Martin, Alex Tongue, Anthony Popelar, Neil Dhingra, Kimberly Callan, Steffi Valkov, Hector Gutierrez, Jonathan Tivald, Kevin Wagner, David Brunell, Daniel Power, Zachary Goff and Francisco Pena.

ED12 0189-02 **NASA photo by Tom Tschida**

Students participating in the STEP program include, from left to right in the back row, Kyle Phipps, Grant Pickett, Alex Graebe, Corey Christiansen and Nathaniel Black. From left to right in the front row are Jorel Estrada, Amber Glass, Camryn Hudson, Lori Stewart, Kalena Shah, Sabrina Piper, and Alexis Bartels.

Dryden researchers publish

Dryden technical publications are available at the Dryden Research Library. Items that are restricted in distribution, such as International Traffic in Arms Regulations, or ITAR, are available in paper form at the research library.

Publications distributed to the public are also available electronically at: http://xnet.dfrc.nasa.gov/Organizations/Library/index.html

Dryden-developed technical publications for May are listed.

John Bakalyar and Christine Jutte co-authored "Validation Tests of Fiber Optic Strain-Based Operational Shape and Load Measurements," AIAA-2012-1904. It was presented at the 53rd Structures, Structural Dynamics, and Materials and co-located conferences, Honolulu, Hawaii, April 23-26, 2012.

Curt Hanson, Jacob Schaefer, Marcus Johnson and Nhan Nguyen co-wrote "Design of Low Complexity Model Reference Adaptive Controllers," NASA/TP-2012-215972.

Claudia Herrera and Adam Harding co-authored "Orion Pad Abort 1 Crew Module Mass Properties Test Approach and Results," AIAA-2012-1396. It was presented at the 53rd Structures, Structural Dynamics, and Materials and co-located conferences, Honolulu, Hawaii, April 23-26, 2012.

Claudia Herrera and Adam Harding co-wrote "Orion Pad Abort 1 Crew Module Mass Properties Test Approach and Results," NASA/TM-2012-215995.

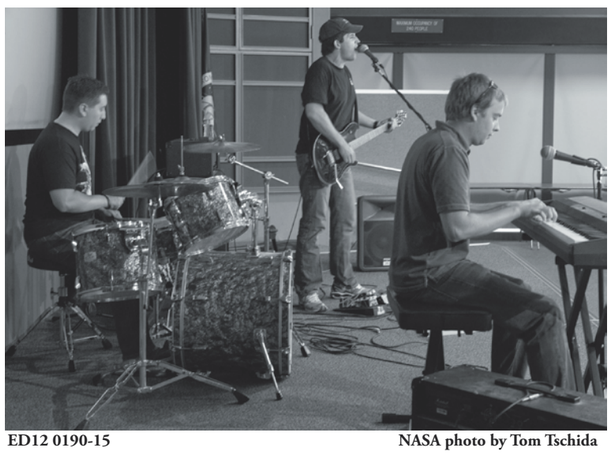
Daniel S. Jones, Syri J. Koelfgen, Marvin W. Barnes, Rachel J. McCauley, Terry M. Wall, Brian D. Reed and C. Miguel Duncan collaborated on "Summary of Propulsion on the Orion Abort Flight Test Vehicles," an ITAR

See Research, page 8

Plane Crazy

Mojave Air and Space Port's monthly open house called Plane Crazy included NASA exhibiters in June. Mary Ann Harness, public outreach specialist, right, and engineering co-op student Sarah Arnac, left, staffed the event. In keeping with the event theme of "Women in Aviation and Aerospace," Arnac and Harness stressed career opportunities for women at Dryden. The event attracted about 250 to 300 visitors. The open house included a number of unique privately owned, general aviation aircraft on display along the flight line.

Courtesy photo



ED12 0190-15 **NASA photo by Tom Tschida**

Bring out the bands

The Avgas Junkies performed in June to kick off the NASA Employee Exchange Council's 2012 Dryden Summer Music Festival. The series of eight free mini-concerts has a different group on Thursdays in June, July and August. The performances are scheduled for the ISF stage from 11 a.m. to 1 p.m. At least one member of the group must be a Dryden employee.

News at NASA

Keiser to oversee strategy

Rebecca Keiser has been selected as NASA's associate deputy administrator of Strategy and Policy. In this role, Keiser will work with the NASA administrator and deputy administrator in the agency's strategy formulation and policy development and integration.

Keiser will oversee the agency's strategy formulation effort to support decisions facing the administrator on a myriad of programs. Keiser will conduct or initiate strategy formulation and policy studies to develop, adopt, disseminate and implement a broad range of policies in furtherance of NASA's goals and objectives. She also will serve as an expert advisor to the administrator and deputy administrator in the analysis and formulation of agency strategies, programs, projects and special assessments.

Keiser previously served as the associate deputy administrator for Policy Integration, a role in which she provided policy analysis and recommendations to the administrator and deputy administrator. Prior to that, she was executive officer for the NASA deputy administrator, a role in which she managed the office's staff, provided policy analysis and advice and facilitated communication across the agency. Keiser also has served as chief of staff for the Exploration Systems Mission Directorate at NASA Headquarters, where she led the front office team responsible for communications and cross-directorate policy formulation. She was the executive officer for the former NASA deputy administrator from 2005 to 2008.

X-Press July 6, 2012

Mars is more than just a Curiosity

By Jay Levine
X-Press editor

An important day for NASA is drawing ever closer as the Mars Science Laboratory carrying its Curiosity rover rockets to Earth's nearest planetary neighbor.

Z. Nagin Cox, a systems engineer at NASA's Jet Propulsion Laboratory in Pasadena, Calif., outlined the mission of the Mars Science Laboratory, or MSL, and its Curiosity Rover during a colloquium presentation at Dryden May 31. Formerly deputy chief of the JPL team that developed the Mars Exploration Rovers, Spirit and Opportunity, Cox currently is a member of the Mars Science Laboratory operations team.

MSL was launched from Earth on Nov. 26, 2011, and is expected to deploy the Curiosity rover onto the Martian surface on the evening of Aug. 5, 2012. Curiosity's landing site is near the base of a mountain inside Gale Crater, near the Martian equator. Researchers plan to use Curiosity to study layers in the mountain that could provide evidence about whether Mars had a wet environment in its early years and could have supported microbial life.

Cox recalled the landing of the Spirit rover on Jan. 3, 2004, which was the first successful Mars mission since the Mars Pathfinder in 1997.

"We were already tired from working around the clock for three years. It was a high-pressure landing, as three of the previous four missions to Mars failed. The British Beagle rover that was to land on Mars on Christmas Day failed," she recalled.

Anxious moments passed in the JPL control room as the team waited to hear a series of tones transmitted from the rover that indicated its progress, she related.

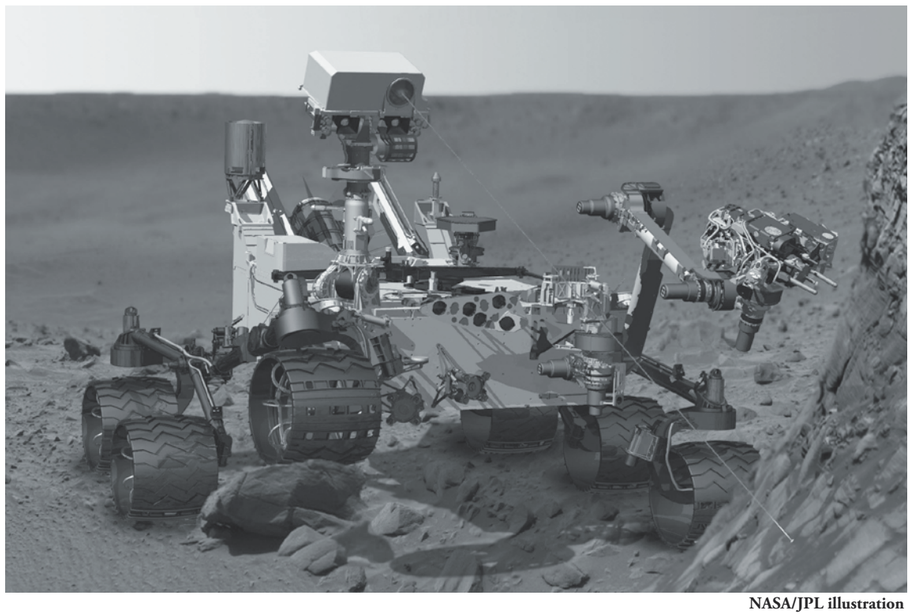
See Cox, page 7

ED12 0171-08 NASA photo by Tony Landis

At left, JPL systems engineer Nagin Cox of the Mars Science Lab operations team outlined the Mars Science Laboratory mission and its Curiosity Rover at a presentation at Dryden. She said the MSL is the most difficult planetary mission ever attempted.

Below, this artist's concept shows the sky crane maneuver during the descent of NASA's Curiosity rover to the Martian surface, which is capable of delivering the large rover to a precise location on the surface.

NASA/JPL illustration



NASA/JPL illustration

This artist's concept shows the Curiosity rover using its Chemistry and Camera, or ChemCam, instrument to investigate the composition of a rock surface. ChemCam fires invisible laser pulses at a target, which is simulated with a gray line. The instrument then views the resulting spark with a telescope and spectrometers to identify the chemical elements.

Curiosity landing expected to be even closer to the mark

By Guy Webster
Jet Propulsion Laboratory

NASA has narrowed the target for its most advanced Mars rover, Curiosity, which will land on the Red Planet in August. The car-sized rover will arrive closer to its ultimate destination for science operations, but also closer to the foot of a mountain slope that poses a landing hazard.

"We're trimming the distance we'll have to drive after landing by almost half," said Pete Theisinger, Mars Science Laboratory project manager at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "That could get us to the mountain months earlier."

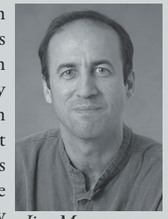
It was possible to adjust landing plans because of increased confidence in precision landing technology aboard the Mars Science Laboratory spacecraft, which is carrying the Curiosity rover. That spacecraft can aim closer without hitting Mount Sharp at the center of Gale crater. Rock layers located in the mountain are the prime location for research with the rover.

Curiosity is scheduled to land at about 10:31 p.m. on Aug. 5. Following checkout operations, Curiosity will begin a two-year study of whether the landing vicinity ever offered an environment favorable for microbial life.

Theisinger and other mission leaders described the target adjustment during an update to reporters in June about preparations for landing

See Landing, page 7

Montgomery set to speak about radar



Jim Montgomery

Dryden employees will have an opportunity to learn more about the Mars Science Laboratory and the radar tested for the Jet Propulsion Laboratory on a Dryden F/A-18 from April to June 2011.

Jim Montgomery, who was the Mars Science Laboratory Terminal Descent Sensor field test lead at JPL is scheduled to speak at the center on July 25 at 1 p.m. in the ISF.

His talk, "Implementing the Mars Science Laboratory Terminal Descent Sensor Field Test Campaign" will describe the planning, design and implementation of the field test campaign, results and lessons learned.

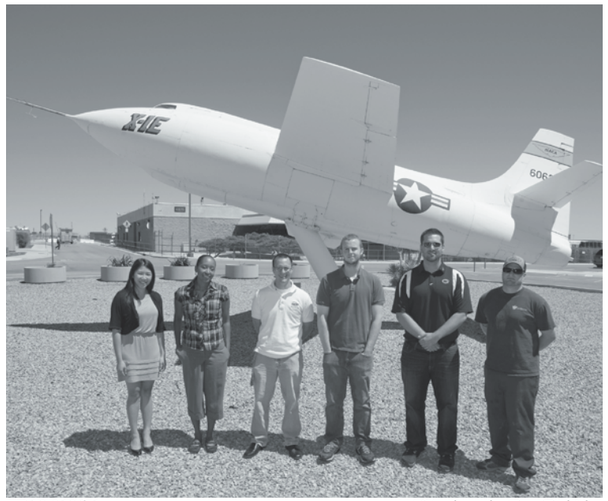
The Mars Science Laboratory will deliver the Curiosity rover to the surface of Mars in August 2012 (see related stories).

To help achieve the rover's delivery, MSL will use a new pulse-Doppler landing radar called the Terminal Descent Sensor, or TDS. Prior to the sensor's use on MSL, the TDS was put through a rigorous verification and validation process. A key element of that work was operating the TDS over a series of field tests, using flight-like profiles expected

See Montgomery, page 8

ED12 0174-18 NASA photo by Tom Tschida

Students who arrived in late June to participate in student programs included, front row from left, Kirsten Fogg, Kimberlee Margosian and Kiara Sgantas. In the back row, from left, are Anthony Macpherson, Elizabeth D'Arienzo, Christopher Busby and James Boyd.



ED12 0196-1 NASA photo by Tom Tschida

Students in the Cooperative Education, or Student Career Experience, program include Jenny Staggs, Tameka Williams, Michael Staab, Ethan Nieman, Tyler Latsha and Jason Nelson.

Students... from page 2

Macpherson, Courtney Marietta, Daniel Power, Jonathan Tivald, Alex Tongue, Kevin Wagner, Kaitlin Wright and Derrik Yabut. The four AERO Scholars are Melissa Barnett, Elizabeth D'Arienzo, Zachary Goff and Sanel Horozovic.

• Four people are participating in the Curriculum Improvements Partnership Award for the Integration of Research at Dryden. The program is structured to assist two- and four-year minority serving institutions to strengthen science, technology, engineering and mathematics, or STEM, and technical programs.

Funding is used to integrate project management methodology to add real world experiences with theoretical knowledge to enhance STEM and technical classes. The aim is to increase the number of underrepresented and underserved students who attain degrees in science, technology engineering and mathematics. Selected for this program were Cheyenne Bolanos, James Boyd, Christopher Ramirez, Kiara Sgantas and Earl Smith.

• The Cooperative Education program, or the Student Career Experience program, integrates college-level academic study with work experience at a NASA center. Students are eligible for permanent employment after successfully completing their education and meeting work requirements.

Students working at Dryden this summer are Sarah Renee Arnac, Casie Clark, Paul Dees, Michael Dorval, Jian Feng, Dan Frecka, Jason Gaume, Victor Gandarillas, Stephen LaPointe, Tyler Latsha, Justin McCarthy, Jason Nelson, Ethan Nieman, Ashley Prueitt, Jeff Requist, Michael Staab, Jenny Staggs, Alexander Stuber, Samuel Sullivan, Seth Trey, Sampson Truong and Tameka Williams.

• Anthony Popelar is a recipient of the Minority University Student in Technology, or MUST, program. The scholarship covers half of a student's tuition up to $10,000 for undergraduate students in engineering and technology in return for work at NASA centers. Participants are limited to U.S citizens pursuing an undergraduate degree in science, technology, engineering or mathematics at a college or university in the United States who are members of an underrepresented group.

• The Science Teacher and Researcher, or STAR, program provides opportunities to science teachers or researchers to work at Dryden. This year's awardees include STAR mentors Yvonne Campos and Ron Hughes and STAR participants Brian Eney, Kristen Fogg, Kimberlee Margosian and Joshua Thompson.

• Contractor Jacobs/Tybrin Corp. works with Dryden's technical branches to fill summer student positions, which this year include Cameron Law and Stephanie Reynolds.

• The Student Temporary Employment Program, or STEP, is also referred to as the Stay-in-School program. It offers temporary employment ranging from summer jobs to positions that can last for as long as the student is pursuing his or her education. Participating in STEP this summer are Greg Alesso, Alexis Bartels, Nathaniel Black, Corey Christiansen, Jacob Copus, Jeremy Duke, Jorel Estrada, Amber Glass, Alexander Graebe, Camryn Hudson, Tatiana Lewis, Kyle Phipps, Grant Pickett, Nancy Pinon, Sabrina Piper, Kalena Shah, Lori Stewart and Daniel Wehunt.

• The NASA University Research Centers, or URCs, offer student opportunities at NASA centers designed to achieve a broad-based, competitive aerospace research capability at the nation's minority institutions. URC's are multidisciplinary research units established at minority institutions to focus on a specific area of NASA interest. The three URC students are working at Dryden and include Jessica Alvarenga, Greg Morales and Francisco Pena.

• Dryden also supported graduate student fellowships this summer. Neil Dhingra was awarded with the Harriet G. Jenkins Pre-Doctoral Fellowship and Helida Haro was awarded with a Graduate Student Researchers Program stipend. Christopher Busby and Zachary Hargreaves received Dryden project-funded scholarships.

Cox ... from page 4

Initially, tones were received that verified that certain tasks were complete. Then, there was nothing. Five minutes of silence passed since tones from the rover were last received. Then 10 minutes elapsed with no communication. At 15 minutes – still silence. Each minute was excruciating, seeming like an eternity, Cox recounted.

At minute 17, the signal came that the rover was fine and images of the planet came a few hours later.

But even with the spectacular success of the Mars Exploration Rovers, "We are not even out of the driveway," Cox said, equating the mission to those of Earth exploration during the 14th and 15th centuries.

While the Spirit and Opportunity rovers are robotic geologists, the Curiosity rover is more of a robotic chemist, she said. Curiosity is about five times larger than the earlier Mars Exploration Rovers and carries more than 10 times the weight of scientific instruments. The 1,980-pound vehicle is about the size of a small sport utility vehicle.

Included are 17 cameras, a laser to study areas to determine if they are worthy of further study, a chemistry lab, a drill, extra drill bits, radiation scanners and the related equipment deemed most important for a successful mission. This new rover also has the autonomy to use terrain assessment tools to determine the best route to areas pinpointed for scientific exploration.

NASA/JPL illustration

In this artist's concept, the NASA Mars Science Laboratory Curiosity rover examines a rock on Mars with a set of tools at the end of the rover's arm, which extends about seven feet. Two instruments on the arm can study rocks up close while a drill can collect sample material from inside of rocks and a scoop can pick up samples of soil for thorough analysis by instruments inside the rover.

Curiosity has steerable parachutes that are expected to allow for a more targeted landing. Curiosity will not use the airbag system used by the previous rovers, because of its much larger size. It will use a suspended "skycrane" system that is expected to allow it to land on its wheels. Although the mission is scheduled for two years, Cox said mission engineers expect the rover to have enough power-generation capability to enable it to function for up to 14 years.

While a sample return mission is still too complex for near-term exploration, Cox said work is under way now to plot future Mars missions.

Many people see Mars in the night sky and it is the closest of the planets to Earth. That's one reason for both casual and scientific interest. NASA began studying Mars with study of the planet's weather, sand dunes and polar caps in 1976 with the Viking mission. The Mars Pathfinder continued Mars studies when the small Sojourner rover landed in 1997, followed by the Mars Exploration Rovers that launched in mid-2003 and landed in January 2004.

NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology, designed and built Curiosity and manages the Mars Science Laboratory Project for the NASA Science Mission Directorate.

Landing ... from page 5

and for operating Curiosity on Mars. The landing target ellipse had been approximately 12 miles wide and 16 miles long (20 kilometers by 25 kilometers). Continuing analysis of the new landing system's capabilities has allowed mission planners to shrink the area to approximately 4 miles wide and 12 miles long (7 kilometers by 20 kilometers), assuming winds and other atmospheric conditions are as predicted. Even with the smaller ellipse, Curiosity will be able to touch down at a safe distance from steep slopes at the edge of Mount Sharp.

"We have been preparing for years for a successful landing by Curiosity, and all signs are good," said Dave Lavery, Mars Science Laboratory program executive at NASA. "However, landing on Mars always carries risks, so success is not guaranteed. Once on the ground we'll proceed carefully. We have plenty of time since Curiosity is not as life-limited as the approximate 90-day missions like NASA's Mars Exploration Rovers and the Phoenix lander."

The mission is managed by JPL for NASA's Science Mission Directorate in Washington. Curiosity was designed, developed and assembled at JPL. Caltech manages JPL for NASA.

Follow the Curiosity

Follow the Mars mission on Facebook and Twitter at: http://www.facebook.com/marscuriosity and http://www.twitter.com/marscuriosity

For more information on the Mars Science Laboratory/Curiosity mission, visit: http://www.nasa.gov/msl

NASA C-20A wraps up Iceland mission

Photo courtesy of the U.S. Embassy in Iceland

The flight and ground crew team of NASA's C-20A Environmental Science Research Aircraft hosted a visit by U.S. Ambassador to Iceland Luis Arreaga on June 11 during an ice cap study mission based in Keflavik, Iceland. From left are Vince Moreno, Carlos Meza, Eric Green (Embassy Deputy Chief of Mission), Bart Henwood, Brittany Martin, Troy Asher, Roger Chao, Brian Hawkins, Ambassador Luis Arreaga, John McGrath and Brent Minchew. Chao, Hawkins and Minchew are with NASA JPL, the remaining flight and ground crew are with Dryden.

DROID ... from page 1

trajectory prediction, and verified the software's nuisance evaluation of single-trajectory versus multi-trajectory flight options.

In all, the phone-on-aircraft software changes functioned well, with the software's multi-trajectory capability providing noticeable nuisance-free flight improvements over its single-trajectory mode.

The flights were conducted within Dryden's Western Aeronautical Test Range, which is part of the restricted military flight-test ranges over Edwards Air Force Base and Southern California's high desert.

"Our last flights represent well over a year of hard work by a highly skilled and dedicated team who have made important steps towards the elimination of controlled flight into terrain accidents," said Jack Ryan, the project's chief engineer.

When fully developed and matured, the miniaturized Auto-GCAS technology could have wide applications for potential use in general aviation aircraft, including both manned and remotely and autonomously operated unmanned aircraft systems.

Dryden and the Defense Safety Oversight Council of the U.S. Department of Defense sponsored the development and adaptation of the automatic ground-collision avoidance software into a smart phone application for unmanned aircraft.

Montgomery ... from page 5

during the descent and landing of MSL over Mars-like terrain on Earth.

The flight envelope over which the TDS must operate on Mars encompasses such a large range of altitudes and velocities that a variety of venues were necessary to test it. For about five years from July 2006 to June 2011 those tests were ongoing and Dryden was one of those places. Other venues used to field test the TDS included a Eurocopter AS350 commercial helicopter and the 100-meter tall Echo Towers at the Naval Air Weapons Station at China Lake, Calif.

Research ... from page 3

meeting paper. It was presented at the 59th Joint Army Navy NASA Air Force, Joint Propulsion Meeting in (JANNAF JPM), San Antonio, Texas, April 30-May 4, 2012.

Daniel S. Jones, Syri J. Koelfgen, Marvin W. Barnes, Rachel J. McCauley, Terry M. Wall, Brian D. Reed and C. Miguel Duncan co-wrote "Propulsion Overview of the Orion Abort Flight Test Vehicle," NASA/TP-2012-216005 (ITAR).

Christopher B. Kostyk authored "Thermostructural Analysis of the SOFIA Fine Field and Wide Field Imagers Subjected to Convective Thermal Shock," NASA/TM-2012-215996.

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