National Aeronautics and Space Administration

INNOVATION

OUR LEGACY · OUR FUTURE

LANGLEY RESEARCH CENTER 2010

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(Left) A model of the Orion crew module with parachutes deployed is tested in the 20-ft. Vertical Spin Tunnel.

LEADERSHIP MESSAGE

Lesa B. Roe, Director

What is your vision for NASA Langley?

We are innovators. Innovation is our legacy and our future. We've proven that over and over. Nearly one hundred years ago, as the National Advisory Committee for Aeronautics, Langley was charged with solving the problems of flight and, in so doing, we launched the aviation industry. Fifty years ago the country's space program was born here in Hampton as our predecessors managed Project Mercury and trained America's first astronauts. Today, we are developing environmentally responsible and game-changing technologies — instruments that take precise measurements of climate change, advanced aircraft that are more environmentally friendly, space technologies that will enable the robotic exploration of distant bodies. I believe Langley's best days are ahead of us. With our work force, we can enable a future … where advancements in air mobility move goods and people, point-to-point, anywhere in the nation and around the world … where climate change concerns are resolved … and where space is open to everyone.

Stephen G. Jurczyk, Deputy Director

What role do Langley's partners and stakeholders play in achieving the vision?

Langley has a reputation as a creative problem solver and is sought out to provide solutions in critical situations. Rather than working in isolation, Langley has always used its diverse network of partnerships that range from small firms and academia to large corporations and other government agencies. Today's accelerating pace of change and the rapid advancement of technology make Langley's partners an even more critical component of the Center's strategy for success. In concert with our partners all over the world, Langley continues to develop innovative technologies and systems. Our record for solving some of the nation's toughest challenges poises us as NASA's innovation engine, to improve the quality of life for all people and contribute to the growth of our regional and national economies.

Cynthia C. Lee, Associate Director

How will Langley employees contribute to the Center's vision?

Any organization's ultimate success depends on its greatest resource – its people. The Langley staff is composed of technically gifted and highly educated engineers, scientists, researchers, technicians, analysts and mission support personnel. It is their collective initiative, creativity and dedication to the NASA mission that sets them apart and enables the Center to accomplish amazing feats. Langley consistently leads the Agency in the number of patents awarded – just one measure of the staff's creativity and drive. To balance these assets with emerging talent, Langley plays a key role in education, offering student programs to create a pipeline to ensure our nation's technological work force. The Langley team is committed to technical excellence and continuous learning to achieve our mission today and prepare for tomorrow.

NASA/LaRC

The first phase of new construction nears completion.

Building the Future of Langley

With most of Langley's buildings more than a half-century old, three new structures are planned to provide state-of-the-art, environmentally friendly work facilities. The first is already under construction, and about 260 leadership and support personnel are slated to move into the 74,000-square-foot building in spring 2011.

Construction on the second building — a 110,000-square-foot conference center, office complex and cafeteria — will begin in April 2011.

A third building was approved in October: a three-floor, 150,000-square-foot Measurements Science Laboratory that will consolidate 60 labs from five other buildings. Completion is scheduled for 2015.

Focus on Efficiency

Most of the buildings being replaced will be, or have been demolished, while several others will be reused.

A significant focus in the building design is on incorporating sustainability features to achieve a LEED (Leadership in Energy and Environmental Design) gold certificate. Standards for LEED certification are determined by the U.S. Green Building Council.

For example, the first new building will include a green roof, which will reduce heating and air conditioning costs. It will extend the lifetime of the roof, absorb storm water and reduce noise transfer.

An environmentally friendly water retention area and pervious pavements will reduce storm water runoff, and low-maintenance geothermal ground source heating and cooling will use renewable energy.

Natural lighting and solar sensors will optimize daylight, and an underfloor air-distribution system will maximize air quality while reducing energy and costs. Photovoltaic solar panels and window films will improve energy efficiency.

Artist's concept of the second phase.

Exploring the Uncharted

Within the coming decades, next-generation spacecraft may not exactly set sail across the solar system, but like their terrestrial ocean-going forebears, they could carry travelers far into uncharted territory. A new NASA heavy-lift rocket may enable travel to the moon and Mars and its moons.

Drawing upon its unique expertise in computational analysis methods and wind tunnel facilities, NASA Langley, in collaboration with Marshall Space Flight Center, is overseeing heavy-lift-vehicle aerodynamics. The Center's critical design process contributions include collecting, analyzing and documenting aerodynamic data to support rocket development.

Langley is also supporting other key exploration areas, including guidance, navigation and control, and structural and thermal analyses. The Center continues to conduct studies to understand how the use of advanced technologies, such as lightweight metallics and advanced composite materials will improve launch vehicle performance.

Major Contributions to Orion

Langley continues to play a central role in the crew-carrying Orion spacecraft, including managing development of the Orion Launch Abort System, which will fly crews to safety in the event of rocket malfunction or other emergencies. The Center also leads testing of additional Orion landing systems options.

The Center is manufacturing a series of Orion flight and ground test articles, the first of which included a command module mass simulator that flew on the first test of the Launch Abort System, called Pad Abort-1 in May (See story on page 6).

In 2010, the Center began upgrading its drop-test facility for water-landing studies to help qualify the Orion crew-module structure. Construction of the water basin is slated for completion in late 2010, with testing of the Orion module scheduled to begin in 2011.

Living and Working Beyond Earth

Langley develops innovative technologies to enable people to live and work beyond Earth's orbit, including:

- Robotics
- Lightweight structures, such as composites
- Advanced sensors and controls for safe landings
- Inflatable structures for building habitats
- Systems and tools for predicting and protecting crews from radiation and other hazards.

In 2010, Langley oversaw the development and delivery of laser and sensor systems to identify and avoid hazardous terrain during precision landings. The Center also contributed to the development of the first aluminum-lithium, friction-stir-welded, spun-formed dome. The result: fewer welds and less weight. Such structures could be used to build the next generation of heavy-lift rockets.

In a mockup of a potential lunar outpost, the Habitat Demonstration Unit-Pressurized Excursion Module is paired with a Space Exploration Vehicle Rover.

In preparation for future safe landings on the moon and Mars, a heavy-lift helicopter carries a 3-D imaging device over Rogers Dry Lake in California to test the system's ability to detect hazardous surface objects.

NASA/Tony Landis

A composite crew capsule was tested in Langley's Combined Loads Test System facility.

NASA/MSFC

To demonstrate the feasibility of reducing the weight and cost of large liquid-propellant tanks, NASA partnered with Lockheed Martin and a German firm to produce a full-scale spherical tank dome made from a friction-stir-welded, spun-formed, aluminum-lithium compound.

Launch Abort System Soars

On an early morning in May, NASA's Pad Abort 1 (PA-1) flight test roared away from the U.S. Army's White Sands Missile Range near Las Cruces, N.M. Little more than two minutes later, the crew module touched down about a mile north of the launch pad.

By the end, PA-1 had proved its worth, becoming the first fully integrated — and successful — test of the Orion launch abort system. PA-1 development was led by NASA Langley in collaboration with other Centers and industry partners. Langley also designed and produced the crew module simulator.

The White Sands flight test involved a tower-like apparatus positioned over a simulated crew module with three motors attached. The first of these, an abort motor, produced a momentary half-million pounds of thrust to propel the crew module away from the pad. It burned for about six seconds, with the most intense impulse occurring in the first 2.5 seconds.

In its upward trajectory to 1.2 miles, the module reached 445 miles per hour in the first three seconds, with a maximum velocity of 539 miles per hour. The second of the trio, an attitude control motor, fired simultaneously with the abort motor and steered the vehicle using eight adjustable thrusters producing up to 7,000 pounds of boost. The attitude control motor kept the crew module on a controlled flight path, re-orienting the vehicle as the abort system burned out.

The jettison motor pulled the entire launch abort system away from the crew module and cleared the way for parachute deployment and landing.

After explosive bolts fired, separating the system from the crew module, the recovery parachute system deployed. The parachutes guided the crew module to touchdown at 16.2 miles per hour (about 24 feet per second), roughly one mile away from the launch pad.

Information gathered from the May launch will help refine design and analysis for future launch abort systems, ensuring safer and more reliable crew escape capability during rocket-launch emergencies.

Our industry partners were key to PA-1's success. Lockheed led the industry team development; Orbital Sciences Corporation of Dulles, Va., supplied design, development and support; Alliant Techsystems, or ATK, of Magna, Utah, developed the abort and the attitude control motors; Aerojet of Sacramento, Calif., developed the jettison motor; and Honeywell of Morristown, N.J., provided avionics for onboard control of abort sequencing and inertial navigation.

The Orion launch abort system lifts off during the Pad Abort 1 flight test in May.

(Right) The launch abort vehicle is prepped for launch at the Orion Abort Flight Test Launch Complex 32E.

U.S. Army White Sands Test Facility

Creating the Future of Flight

As the nation transitions to an expanded and improved airspace system to provide increased air mobility on demand, in 2010 Langley continued to address a number of key aeronautics research questions.

Can aircraft be environmentally friendly? Can airborne self-separation be achieved without intervention by ground controllers? Can structurally compromised aircraft self-correct to avoid loss of control? Can new materials and structures lessen the destructive force of a helicopter crash? Can a new type of engine propel aircraft to more than 3,000 miles per hour?

The answer to each of these questions is a resounding "yes." Langley engineers and scientists are actively exploring ways to create a future for flight that is safer, quieter, more fuel-efficient and, crucially, substantially lessens or eliminates any potential environmental harm resulting from an accelerated pace of aircraft operations.

Tests at Langley's 8-Foot High Temperature Tunnel preceded the successful launch of the X-51A off the California coast in May.

Greener, Faster Aircraft

NASA's Environmentally Responsible Aviation (ERA) project is developing a host of green technologies to meet environmentally demanding goals. For example, Langley researchers are studying advanced composite materials that will allow for the construction of stronger, lighter airplanes. Such structures could also be applied to minimize the weight of supersonic aircraft.

Recently completed advanced-concept studies have identified potential low-sonic-boom supersonic configurations. Integrated high-propulsion systems are also being evaluated, as are low-drag and very-low-emissions approaches. The ultimate goal is to make faster than sound aircraft just as environmentally benign as their subsonic counterparts.

Safety Below and Above

Helicopters generally operate in harsh environments, performing search-and-rescue, medical evacuation and law enforcement missions, while flying close to the ground, not far from power lines and other obstacles. In 2010, full-scale helicopter crash tests took place at Langley to determine if an expandable honeycomb cushion could lessen the destructive force of impact. Data from these tests will be used to improve crash-dynamic predictions, perhaps leading to stronger airframes to increase crash survivability.

In 2010, Langley researchers also completed a simulation of airborne self-separation using satellite-based navigational systems to assure separation without intervention by ground controllers. This experiment was conducted in Langley's Air Traffic Operations Laboratory, and involved 48 U.S. and European commercial airline pilots flying in simulated high-traffic airspace.

Advancing Hypersonics Flight

Hypersonics, a discipline that examines flight at more than five times the speed of sound, took an important step forward in 2010 with a successful Mach 5 flight of the Air Force/DARPA X-51A in May from Edwards Air Force Base. The X-51A uses a novel air-breathing propulsion system called a scramjet. Final flight qualification ground tests of the X-51A were conducted at Langley. Larger X-51A versions may lower the cost of placing payloads and crew into orbit.

Evaluating Control Concepts

Because NASA engineers are looking for ways to prevent loss-of-control accidents, understanding aircraft behavior in abnormal conditions is key. Structural damage, hydraulic failures, or icing buildup may dramatically alter aircraft controllability. Researchers have been involved in the Airborne Subscale Transport Aircraft Research program, in which pilots have evaluated fully adaptive control concepts implemented under emergency conditions.

(Far left) Greg Howland works with a flight-test model on a runway.

(Left) Researcher Dan Murri remotely pilots an AirSTAR — Airborne Subscale Transport Aircraft Research — generic transport model from inside a specially equipped control room on wheels.

Chopper Test a Smash Hit

The crash test of a small lightweight helicopter in March was a smashing success, literally — just as engineers had predicted.

"Three, two, one, release," said the technician on the loudspeaker at Langley's Landing and Impact Research Facility. With that countdown the helicopter smacked hard into the concrete. Its skid gear collapsed, its windscreen cracked open and its occupants lurched forward violently, suffering potentially spine-crushing injuries, according to internal data recorders. The crash test was all in the name of research to try to make helicopters safer.

"The goal of any research program that has an element of impact dynamics is to develop an understanding of the crash response of the vehicle," said Karen Jackson, an aerospace engineer who oversaw the test. "Once we understand that response, we can look at ways to improve the crash performance."

In December 2009 researchers dropped the same MD-500 at a similar angle from the same height of 35 feet. Inside were the same data collection instruments and the same four crash test dummies. Technicians set up the same cameras to record the impact from inside and outside the helicopter.

The test conditions on both days were the same too, simulating what would be a severe but survivable helicopter crash. In the first test the MD-500 skidded to a stop with little damage to the helicopter or its silent occupants, because its underside was outfitted with an expandable honeycomb cushion called a deployable energy absorber.

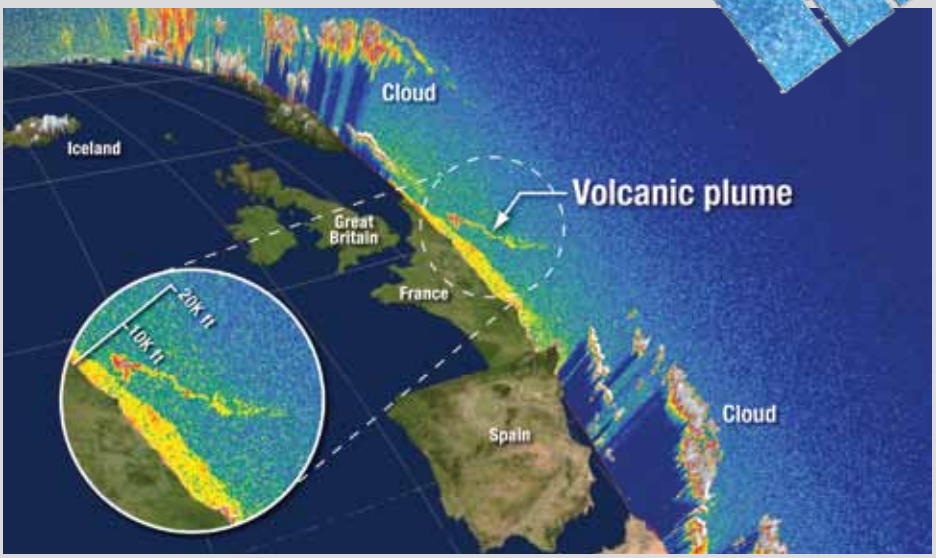
"It's made of Kevlar and has a unique flexible hinge design that allows the honeycomb to be packaged and remain flat until needed," said Sotiris Kellas, the Langley engineer who initially created the idea as a way to cushion space capsules.

The more recent drop on March 10 involved just the helicopter. No new technology was attached. Engineers wanted to determine exactly how efficient the deployable energy absorber had been in the earlier test and how much it might help reduce occupant injuries. So they dropped the same helicopter in the same way and measured and recorded the same conditions with the same instruments.

"We were fortunate enough that the helicopter survived so well the first time that we could use it again," said engineer Martin Annett.

Engineers now have gigabytes of data to analyze what impact the honeycomb cushion technology might have for helicopters.

Researchers dropped a helicopter to see if a deployable energy absorber lessened the force of the crash.



This image shows a plume from the eruption of the Eyjafjallajökull volcano in Iceland drifting over Paris last April. The image is made from data collected by NASA's CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) satellite.

Passion for a Safer Planet

NASA Langley scientists measure, monitor and model Earth's atmosphere, how it's changing, and how that change affects everything from air travel to air quality to global climate. We develop instruments and measurement techniques for land, air and space. In so doing, we've amassed one of the world's most comprehensive and precise collections of climate data.

Langley's King Air B200.

Daily atmospheric conditions averaged over time — precipitation, wind, clouds and sunny days — are what we define as climate. At Langley, our goal is to understand how and why climate and the atmosphere act the way they do. Then we translate what we've learned into meaningful information that inspires action by decision makers.

We are passionate about our quest to understand what is truly changing on Earth, so that all the information we collect from the research we conduct, the missions that we run and the instruments that we fly in the air and in space can collectively be put to use for the greater good: a safer planet and a better tomorrow.

Something in the Air

In 2010, Langley's Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite captured unique images of the Icelandic volcano Eyjafjallajökull's ash cloud, and also tracked the movement of a 1,000-mile-wide dust plume from China all the way to the eastern U.S. CALIPSO is the only satellite capable of providing vertical profiles of clouds and small particles in the atmosphere called aerosols. The data is vital to the Center's research in climate change, air quality and aviation safety.

Langley scientists traveled the country in 2010 with the High Spectral Resolution Lidar (HSRL) on board the NASA King Air B200 aircraft to study the climate impact of pollution and natural airborne particles. The HSRL is the leading candidate for a proposed lidar instrument — a laser-based device used for remote sensing — on the future Aerosols, Clouds and Ecosystems mission. The Center also coordinated a flight demonstration of carbon dioxide measurement capabilities, experience that should prove invaluable in leading or supporting upcoming missions.

Unprecedented Accuracy

In 2010, Langley scientists generated the first decade-long global climate data record of the balance of energy entering Earth's atmosphere and radiating back to space, using data from Clouds and the Earth Radiant Energy System and other imager instruments. Center researchers also developed the first high-quality, four-year global dataset of cloud and aerosol vertical profiles compiled from CALIPSO. These two data collections will be used to enable fundamental improvements in climate prediction models and in the next international assessment of climate change.

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission, led by NASA Langley, is being developed to achieve unprecedented accuracy in climate measurements. CLARREO completed its mission formulation phase this year, bringing it one step closer to launch later this decade.

Working closely with international partners, the Surface Meteorology and Solar Energy (SSE) project is developing the commercial potential of NASA's cloud, radiation and meteorology data. The SSE website has seen nearly 14.0 million total hits and 2.8 million data requests since inception in 1999.

Eye to Eye with Earl

White-knucklers they're not.

Researchers from NASA and science organizations around the world spent the better part of the summer flying head-on into hurricanes. Like Hurricane Earl, the category 4 powerhouse that ripped up the Atlantic.

It was NASA's biggest hurricane research campaign in a decade.

Three teams from Langley, about 20 people in total, spent two months this summer in Fort Lauderdale, Fla.. The teams made 15 science flights aboard NASA's DC-8 as part of the Genesis and Rapid Intensification Processes (GRIP) campaign.

GRIP was designed to help scientists answer some of the most fundamental yet still mysterious questions about hurricanes: How exactly do they form, and what factors make them into stronger storms?

Better Forecasting

Better answers to those questions could help forecasters improve predictions of a storm's intensity at landfall. Currently, forecasts of storm strength are not nearly as accurate as predictions of a hurricane's track and where it will make landfall.

GRIP put a variety of scientific instruments on three NASA planes — the Global Hawk drone, the WB-57, and the DC-8 — to fly over hurricanes and tropical storms to capture key moments of storms forming and intensifying, or even fizzling out.

The Langley instruments in GRIP were the Lidar Atmospheric Sensing Experiment (LASE), the Langley Aerosol Research Group Experiment (LARGE) and the Doppler Aerosol Wind Lidar (DAWN). While LASE and LARGE had flown in previous missions, DAWN, designed and built at Langley, was making its first appearance in the field.

DAWN principal investigator Michael Kavaya said the instrument is one of the most powerful solid-state wind lidars ever built, which allows it to punch through thin clouds. Designed to measure wind, DAWN is also one of the first airborne wind lidars to measure wind speeds vertically as well as horizontally.

"It's really gratifying," said DAWN team member Grady Koch, "to put the instrument in the field after years of working on it."

LASE measures water vapor, aerosols and clouds, key ingredients in the recipe of a potentially boiling hurricane.

New Understanding

Particularly significant were LASE observations made over Hurricane Earl in August. The DC-8 flew back and forth over the storm as it intensified, capturing the observations GRIP was designed to get. LASE observed the development of Earl's eye as it reached hurricane strength.

"We believe that's the first time that's been done," said LASE principal investigator Syed Ismail.

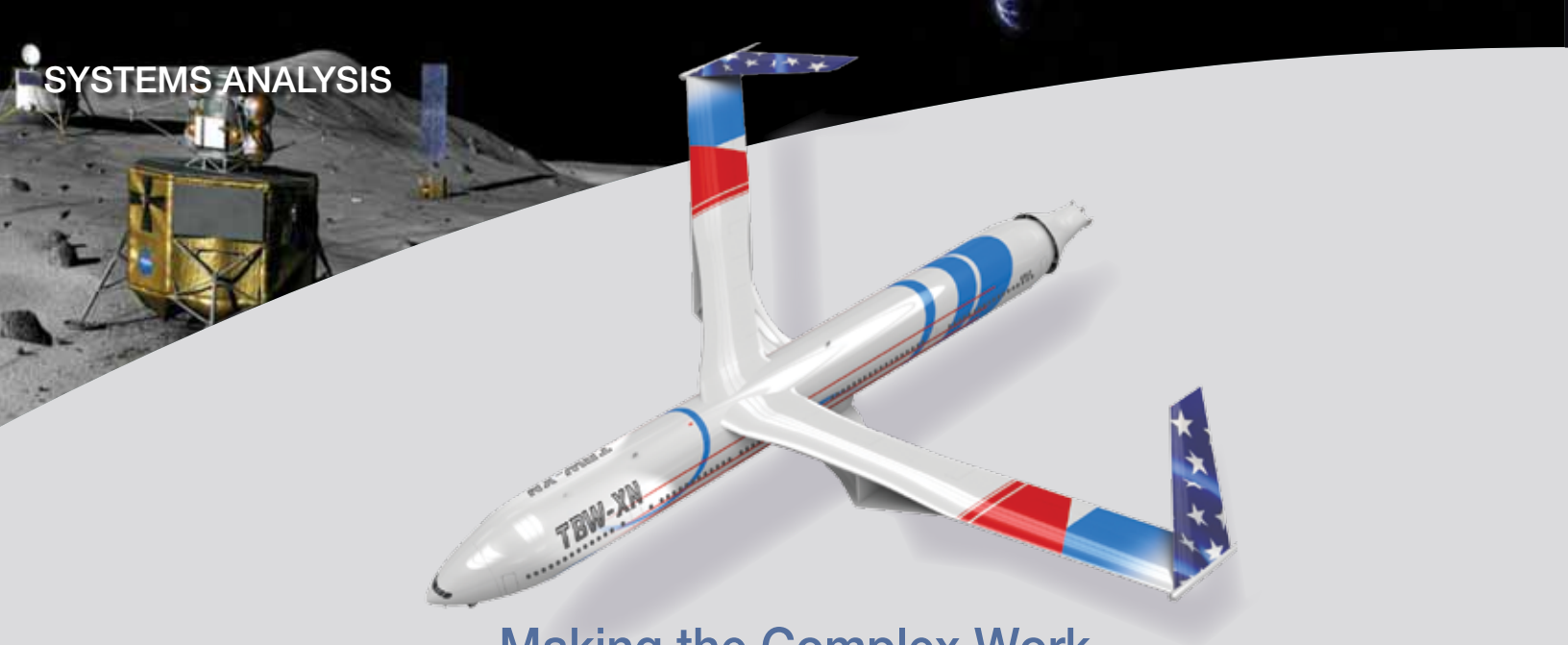
The two-month flight portion of the GRIP campaign for the DC-8 wrapped up with a final flight — from St. Croix, so the team could fly farther into the Atlantic.

Ideally, new understanding of hurricane behavior can be incorporated into forecasting models to better predict when and where storms will hit land, and how strong they will be when they do so. "What impact all this has," Ismail said, "will come out in the models."

Langley's Michael Kavaya, principal investigator for the DAWN experiment, looks over data with Jeffrey Beyon during a flight of NASA's DC-8 over the Gulf of Mexico in August.

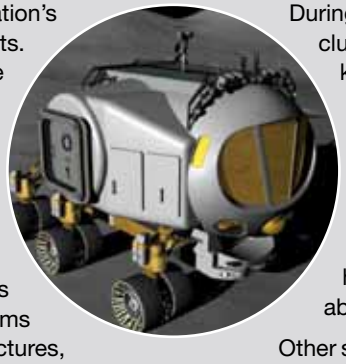
Syed Ismail, a Langley principal investigator for the Lidar Atmospheric Sensing Experiment, discusses hurricane data while aboard the DC-8 research airplane.

NASA/Paul E. Alers



Making the Complex Work

Doubling, or even tripling, the capacity of the nation's airspace system. New airplanes and new rockets. Vehicles that one day could fly from airports to the edge of space and perhaps beyond. Earth-observing satellites, global environmental health, even lunar dwellings.



All this NASA research must be assessed and validated. Complex systems are comprised of many elements that must work smoothly together. Making sure that happens is the goal of Langley's systems analysis experts, who address broad systems perspectives such as: What are the possible architectures, concepts and approaches to fulfill a mission? What systems and technologies optimally enable these approaches? What are the associated costs and risks?

In 2010, systems analysis at Langley undertook a number of notable projects in support of NASA initiatives. Reviews ranged from aviation safety to potentially environmentally neutral aircraft to new spacecraft and remote-sensing systems.

21st Century Aeronautics

As the nation begins an unprecedented transition to what is known as the Next Generation Air Transportation System, or NextGen, planners must gauge the impact of a dramatic increase in air traffic. Affected areas range from air traffic operations to aviation safety to on-ground congestion at airport metroplexes, even aircraft design. Each area features potentially revolutionary performance gains. Accordingly, in 2010, NextGen aeronautics research efforts were analyzed and assessed by our experts.

During 2010, Langley systems analysis studies also included assessments of the emerging class of aircraft known as hybrid wing body, and truss-braced-wing-fuselage designs and concepts that could lead to major improvements in aerodynamic efficiencies and significant reductions in harmful emissions. Because Langley leads hypersonic systems analysis for NASA, we also examined ways the Agency is applying air-breathing propulsion technology to high-speed atmospheric flight, as well as highly reliable, responsive space access.

Other systems analysis evaluations were ultra-high-bypass ratio engine-airframe integration concepts that would substantially reduce polluting emissions and noise while boosting engine fuel economy, as well as low sonic boom, supersonic aircraft design.

Reliable Architectures for Earth and Space

In 2010, Langley's systems analysts played a significant role in defining reliable space exploration architectures. The Ares V rocket shroud design and Ares I aerodynamic database development were also supported. Our analysts evaluated the feasibility, design, development and fabrication of potential lunar vehicles and habitats.

Langley continues to provide systems analysis support to the International Committee on Earth Observation Satellites, evaluating the Earth-observing fleet of satellites currently in orbit. Our ultimate goal is to develop options to ensure that requirements for performance and reliability are met, and solutions are affordable and timely.

(Above and top of page) Artist's concepts of a truss-braced-wing design.

From Laboratory to Marketplace

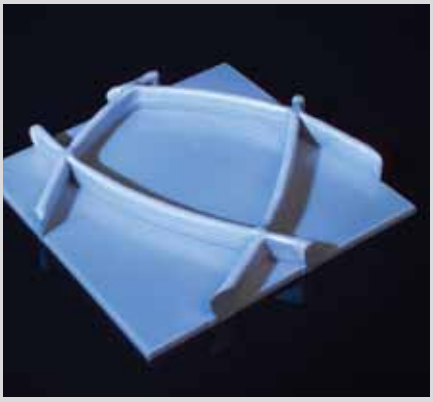
Jumpstarting innovation by collaborating with others is the focus of Langley's Innovative Partnerships Program (IPP), part of the Center's Strategic Relationships Office. To solve technical challenges inside and outside of NASA, IPP promotes Langley's unparalleled resources — its expertise, facilities and technologies — to create traditional and nontraditional partnerships worldwide with small and medium firms, large corporations, academia, and partners within the federal government.

To help move Langley's work from the lab to the marketplace, IPP works closely with Center researchers who are inventing and patenting new technologies. One example: an airfoil design for a high-performance tail rotor for the popular Bell 206 helicopter. Compared to existing blades, the new rotor is far more durable, reduces noise by 40 percent, and displays enhanced capabilities at high altitudes. These improvements benefit helicopter performance for law enforcement, military training, wildfire and pipeline patrols, and emergency medical services.

IPP has also helped transfer ultrasonic wire-crimp technology to the commercial market. Such systems are able to assess critical connections on electrical wiring systems in commercial and military airplanes, and will be sold to measure the quality and durability of wire crimps for automated assembly operations in aerospace, military, automotive, and other high-reliability market niches.

Going Inventively Green

A Langley Innovation Seed Fund grant helped researchers develop sensors and algorithms to enhance their "portable infrasonic detection system" invention. Originally developed to detect clear-air turbulence, the system can now be used in earthquake detection, the prediction of environmental and weather conditions, and for general purpose sound-pressure testing. Langley has signed a nonexclusive license agreement, and the technology has been recognized by the Hampton Roads Technology Council with its Green Economic Alliance Green Innovation Award.



This metallic structure is an example of fabrication using the EBF^3 process.

Bell Helicopter

A Bell 206 helicopter.

New Technology

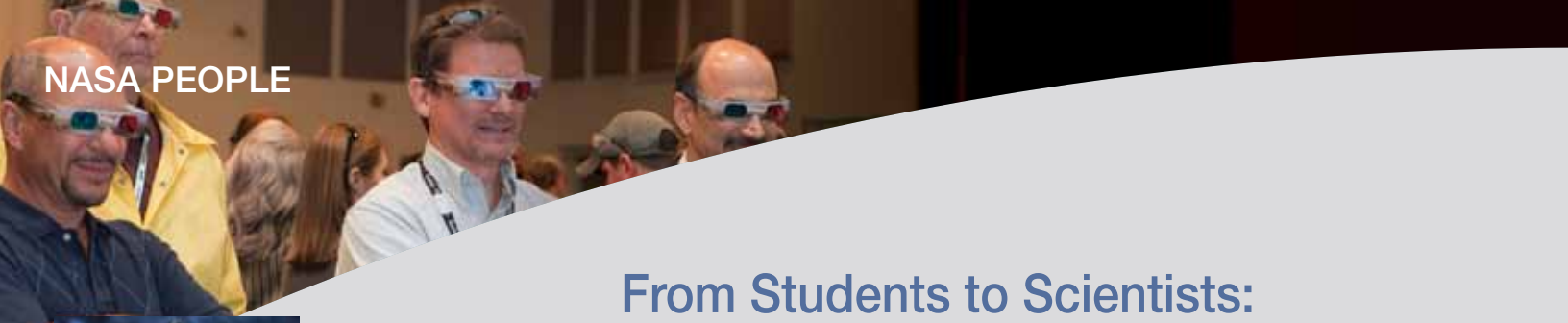
A semiconductor material for microelectronic chipset application invented at Langley was honored with a 2009 R&D 100 Award from R&D Magazine. The innovation also led to the discovery of a new engineering model that enables the fabrication of thousands of new alloys and millions of new device structures.

Researchers from Langley and Johnson Space Center continued collaborating on a novel fabrication technology, electron-beam freeform fabrication, or EBF^3, a layer-additive process that uses an electron beam and a solid-wire feedstock to fabricate metal structures. The process can be used to manufacture parts, tools, and spare parts in space. A smaller EBF^3 version could be employed for terrestrial applications, on naval vessels and oil rigs, in army depots, and within remote outposts.

Small Business Partners

Small companies and research institutions around the country work closely with Langley researchers on technologies for NASA's projects and programs. For instance, Center engineers have partnered with a Montana company to develop new, compact, lightweight electro-optic components for remote sensing systems. The components are part of a sophisticated instrument used to study clouds and aerosols, and has flown on NASA Langley's B-200 aircraft on missions to the Gulf region, California, the Arctic, and Mexico.

Through its TecFusion Forums, Langley has also provided opportunities for a number of its small business partners to present and discuss their technologies to larger businesses in a wide variety of technology areas. The forums facilitate the transition of technologies developed in federal programs to new commercial products, which in turn spurs economic development through jobs created. During the 2010 fiscal year, a dozen events were held.



From Students to Scientists: It's About People

Who drives the innovation engine at Langley? The people. Employees, partners and students who intern here — including some who return as part of the work force.

Langley's science, engineering and technological innovations are enabled by a highly skilled, educated and experienced work force that leverages diversity of experience and ideas to meet the challenges of aeronautics, space and atmospheric science.

Seventy-six percent of Langley's 1,946 civil service employees work in science and engineering or are technicians. Twenty-five percent provide administrative and clerical support.

Nineteen percent of Langley employees hold doctorates, 31 percent master's degrees, 26 percent bachelor's degrees, 13 percent associate degrees, and 11 percent have a high school education or less. And the average civil service employee has 20 years of federal service, providing a wealth of experience to NASA.

Langley's mission accomplishments are enabled by the 1,869 on- and near-site contract employees. Langley also has a diverse student population that is a critical element of the work force pipeline.

Skill Diversity

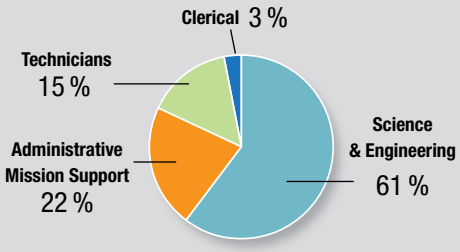
Langley's work force possesses a diversity of skills. Four occupation categories encompass a variety of positions and areas of expertise. For example, science and engineering positions include aerospace, structural, mechanical, computer and electronics engineers; physical scientists; and mathematicians and physicists.

Mission support fields include human resources, finance, procurement, information technology and legal. Engineering and electronics technicians account for most technician positions, though the Center also employs quality-assurance and equipment specialists.

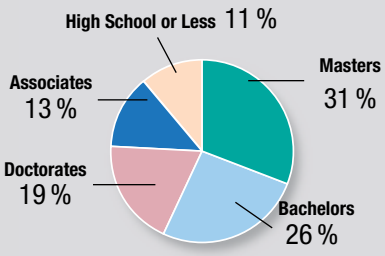
Clerical positions include secretaries and administrative assistants.

So we're more than labs, software and equipment. We're people.

Civil Service Occupational Distribution



Civil Service Education Levels



Numbers may not equal 100% due to rounding

(From top) A few Employees enjoy a Mars 3D exhibit; Anna McGowan; Chris Savage; Susan Cooper; Lorna Ragland (right) and one-year-old Claire.

(From left) Luckey Thomas; George Finelli; Wei Zhang; Angela Wade and Yolanda Simmons

Intern Discovers More Than Math and Science at NASA

As I walked through Florence on March 15, only one thing was on my mind: I had a NASA interview at 6 p.m.

Since I shared a room with another student in an old apartment with an Italian host family, I coordinated with everyone to make sure it wouldn't be loud and that I had working wireless.

It Was Time

Sure enough, at six o'clock sharp, I got a phone call through my online Skype number, showing up as a 757 area code. It was my soon-to-be News Media Team mentor. Twenty minutes later, the interview was done. At that point, all I could do was pray, hope for the best and continue to enjoy my semester abroad program.

When most people think of working at NASA, they think astronauts, space, engineering and a lot more science. My specialties are public relations and foreign languages.

Waiting for the outcome, I was skeptical I could get a job at NASA, especially since my main interests aren't science focused. Four days later, I received a call that changed my summer.

While sitting on a terrace overlooking a beautiful Italian beach in a city called Monterosso, my little plastic Italian phone started to ring. It was my mom.

She explained that my mentor called her because I didn't have an international cell phone. And they wanted me to intern in the Strategic Relationships Office. I was ecstatic!

That weekend was just the beginning. When coming home to America, I longed to go straight back to Italy, but I knew I had something exciting ahead of me.

Sasha Congiu's specialties are public relations and foreign languages, talents NASA needs.

From day one, the News Media Team gave me a warm welcome to its staff. The team put me right to work, writing a news release about the new student interns and sending it to newspapers, radio stations, colleges and universities throughout the U.S. In the first week, I wrote about 30 student releases and was ready to take on whatever they threw at me next.

The weeks that followed flew by. I wrote hometown press releases for a student education program. I conducted interviews and sent the releases to news media and schools all over Virginia.

Writing press releases was a great experience, but doing feature stories was when my passion for writing was revealed.

I wrote stories on various topics, including the zero gravity flight experience and a NASA art contest. It's amazing to me when I go to the NASA web pages and see something written by me, with my name on it.

In addition, I learned I worked well under pressure. I gained experience reporting and writing stories all in one day. And one of those stories apparently is going to have a lasting impact.

Because of a story I wrote involving NASA Administrator Charles Bolden and astronaut Leland Melvin, I was asked to write a message for an education exhibit at the Great Hall in NASA headquarters in Washington, D.C. Talk about a thrill!

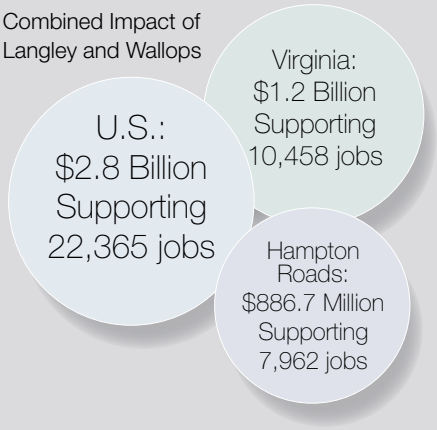
There was more that I did this summer, but I'd need to write a whole book to fit it all. I will leave with this: I made the most out of my summer, with every opportunity given to me, and it was one of the best learning experiences I've ever had.

— Sasha Congiu,
James Madison University





Danielle Jackson; Linwood Smith; Pat Quander-Haas; C.T.Moore, and Liz Ward with a new friend.

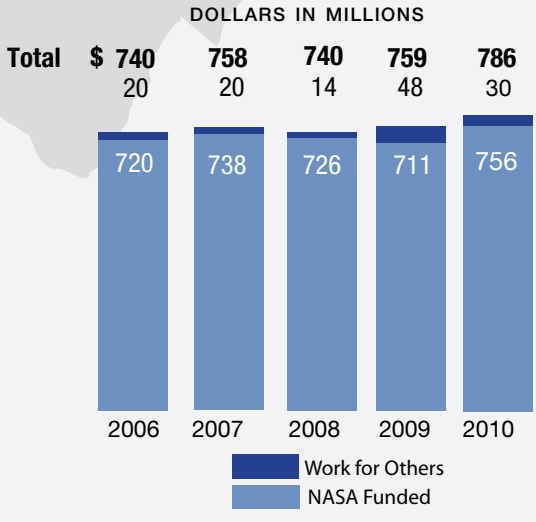


NASA's Economic Impact Increases

Langley Research Center and Wallops Flight Facility on Virginia's Eastern Shore have a significant impact on the economy of the region, state and nation.

Langley had a $786 million budget in fiscal year 2010, an increase over the previous year. As a result, the center's economic impact grew, according to Chmura Economics & Analytics, a Richmond, Va., company retained to assess Langley's direct and indirect economic impact.

"Each year, NASA Langley Research Center and Wallops Flight Facility spend hundreds of millions of dollars at regional businesses for the procurement of supplies and services necessary to support daily operations," Chmura said. "Their employees spend a significant amount of their earnings in the regions, which supports local businesses."



In 2010, Chmura said, "the economic impacts of NASA Virginia operations increased 3.7 percent in terms of spending, and two percent in terms of job creation."

Economic Impact of Langley Alone

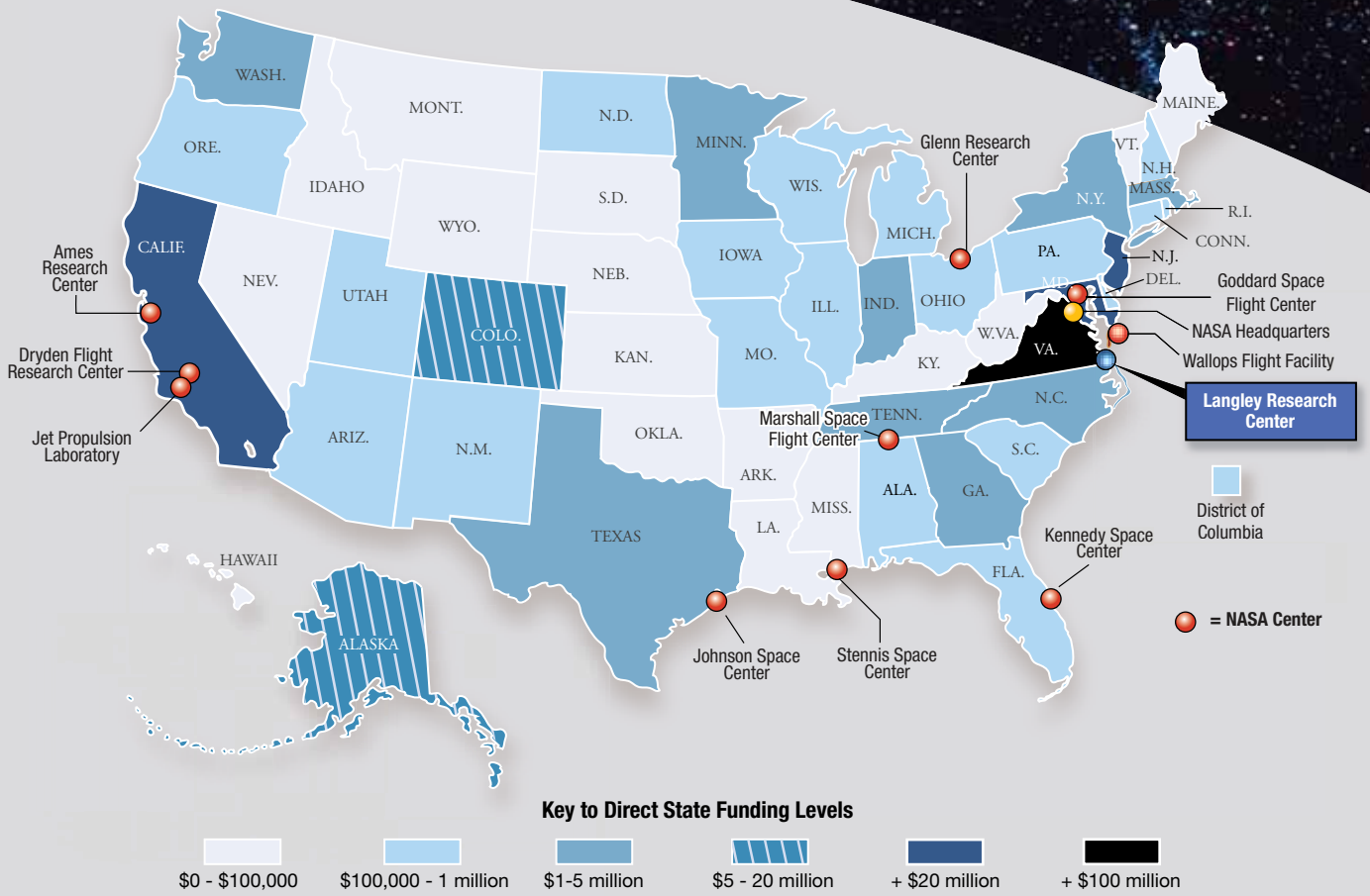
- U.S.: $2.1 billion that supported 16,865 jobs
- Virginia: $946.8 million supporting 8,624 jobs
- Hampton Roads: $886.7 million supporting 7,962 jobs

Combined Impact of Langley and Wallops

- U.S.: $2.8 billion supporting 22,365 jobs
- Virginia: $1.2 billion supporting 10,458 jobs
- Hampton Roads: $886.7 million supporting 7,962 jobs

Langley's facilities, covering 788 acres, represent a $3.3 billion investment in land, buildings and equipment. Some 3,800 people work at Langley, including 1,946 civil service and 1,869 contract employees.

As Langley prepares for new missions and programs, infrastructure investments are generating more economic benefits. Langley's future includes new state-of-the-art green buildings in its New Town to replace aging structures. Six buildings are planned over 15 years. They include three labs, two office buildings and a joint-use facility.



Top Obligations to Business Contractors

Jacobs Technology, Inc.	$ 77,597,444.45
ATK Space Systems, Inc.	48,158,105.53
Science Systems and Applications, Inc.	33,828,546.00
Raytheon Technical Services Company	26,772,314.87
Boeing Company	24,185,824.10
Lockheed Martin Corp.	18,167,128.57
Tessada & Associates, Inc.	16,303,722.00
Science Applications International	12,382,651.93
Analytical Mechanics Associates, Inc.	10,961,358.34
Unisys Corp.	6,072,429.65
ASRC Management Services, Inc.	5,885,659.23
Chugach Industries, Inc.	5,078,712.05
Dominion Virginia Power	4,162,553.35
Safety & Quality Assurance Alliance	3,982,499.00
CSC Applied Technologies, LLC	3,894,935.78
Honeywell International, Inc.	3,501,147.10
Intentional Leadership, Inc.	3,137,860.70
Science and Technology Corp.	3,032,047.00
Mosaic ATM, Inc.	2,962,938.00
Alliant Techsystems, Inc.	2,359,790.48
Northrop Grumman Systems Corp.	2,243,740.00
Northwest Research Associates, Inc.	1,869,747.00
Triumph Aerospace Systems	1,742,741.08
Modern Machine And Tool Company, Inc.	1,739,608.39
Sensis Corp.	1,707,802.00

Top Obligations to Nonprofit and Educational Institutions

National Institute of Aerospace	$ 22,158,661.82
The City of Hampton, Va.	3,697,688.00
Pennsylvania State University	3,363,319.00
The Aerospace Corp.	3,167,019.76
Morgan State University, Inc.	3,000,000.00
Georgia Tech Research Corp.	1,796,399.45
West Virginia Univ. Research Center	1,500,000.00
Virginia Tech	1,333,313.29
Cal Poly Corp.	1,299,077.00
Wheeling Jesuit University, Inc.	1,209,915.00
University of Wisconsin System	1,185,816.00
President & Fellows of Harvard College,	1,043,158.00
University of Florida	845,576.00
Purdue University	781,923.33
The Virginia Air and Space Center	718,000.00
Middle Tennessee State University	681,639.19
National Wildlife Federation	670,525.00
Biological Sciences Curriculum Study	647,168.40
Old Dominion University Research Foundation	634,382.78
Wichita State University	600,000.00

Telling the NASA Story

What do NASA and Busch Gardens have in common?

Both have stellar attractions to educate and entertain. For NASA, it was former astronaut Roger Crouch appearing at Busch Gardens for NASA Exploration Days. Crouch and NASA activities were on parade for two days at the entertainment attraction.

The event was just one of many events designed to educate and inform.

Langley hosted hundreds of students in education programs in the past year. One example: The Virginia Aerospace Science and Technology Scholars (VASTS) program. Students in a weeklong residential summer academy are immersed in research with scientists, engineers and technologists, working interactively online.

Langley also took part in the Summer of Innovation, and the FIRST Robotics competition for students in Richmond. The robotics event was created in 1992 by Segway inventor Dean Kamen, who visited Langley in August to talk with employees, while the Summer of Innovation springs from President Barack Obama's Educate to Innovate campaign for excellence in science, technology, engineering and mathematics, or STEM, education.

For sheer intergalactic dazzle, it was hard to beat Yuri's Night Hampton Roads, held at the Virginia Air & Space Center. The annual event celebrates space exploration and is named after the first human in space, the Soviet Union's Yuri Gagarin.

TEDxNASA

And for the second year, Langley hosted TEDxNASA, a unique daylong series of speakers designed to promote the exchange of ideas worth spreading on this year's theme, "What Matters Next." Langley also kicked off the new TEDxYouth@NASA, which rallied middle and high school students around the theme "Be Astronomical."

In keeping with NASA's emphasis on studying the environment, Langley sponsored EarthFest in October at Sandy Bottom Nature Park in Hampton, Va., a public celebration with exhibits, entertainment and activities.

During the first Langley Day of Education, employees took the NASA experience to more than 30,000 students. A similar effort by Langley atmospheric scientists reached students in New Orleans.

And from better brakes and safer tires to heat-resistant paint and cleaner emissions, NASA's contributions to the racing world were featured in the traveling exhibit: "From Rockets to Race Cars" at NASCAR events around the country.

In November, the Virginia Association of Science Teachers held its annual meeting around the theme "A Vision for Innovation" at the Virginia Air & Space Center in Hampton, Va. Langley's director, Lesa Roe, spoke to the 300 participants, reinforcing the relevance of science.

NASA Langley supported the MODSIM World Conference STEM event in October. The "Dream-Create-Go!" theme was part of the USA Science and Engineering Festival.

Futurists, visionaries, entrepreneurs and technologists explored the future of aeronautics at "Aviation Unleashed," a three-day forum sponsored by Langley and the National Institute of Aerospace in Hampton, Va.

Two NASA video shows produced at Langley won accolades for quality.

NASA 360 — aired on TV stations and websites — was nominated for two Emmys and added dozens of new stations to the lineup. The most recent 360 episode was downloaded more than 1.7 million times.

NASA EDGE was nominated in the Best Video Podcast category of the annual Podcast Awards, and passed the 13-million mark in downloads, magazines, radio, the Internet and TV.

(Left) Costumed guests join in the celebration at Yuri's night at the Virginia Air & Space Center.

(Above) Excited students at the TEDxYouth@NASA event.

Astronaut Roger Crouch talks with guests at Busch Gardens.

NASA Day of Education

CIAA Education Day

EarthFest

TEDxNASA

VASTS Program

NASA 360

Left to right from top left: Dan Pritchard shows pictures to Ashley Beck's fourth-grade class at Hilton Elementary School in Newport News, Va., during NASA Langley's Day of Education; Astronaut Leland Melvin talks with students at the Central Intercollegiate Athletic Association Tournament in Charlotte, N.C., in February; Inside the NASA dome at EarthFest at Sandy Bottom Nature Park in Hampton, Va., NASA Chief Technologist Robert Braun speaks at TEDxNASA held in October at the Ferguson Center for the Arts in Newport News, Va.; VASTS participants examine a Mars globe; Jennifer Pulley co-host of NASA 360, a popular half-hour TV program produced at Langley.

Gateway to the Universe ... and Beyond!

A trip to NASA Langley's neck of the woods isn't complete without a visit to the Virginia Air & Space Center (VASC) in downtown Hampton. It's a must-see spot for vacationers — especially those with kids — featuring mind-boggling exhibits, activities, and an IMAX theater.

Serving as the official visitor center for NASA Langley since 1992, the VASC is home to more than 30 historic aircraft, interactive exhibits and unique spaceflight artifacts that showcase NASA Langley's role in the past, present and future of aerospace.

The VASC is guided by a mission to educate, entertain and inspire the next generation of explorers, and served more than 402,000 visitors in 2010. Some 240,000 of them were children.

Providing Opportunities

The VASC also sparks interest in science, technology, engineering and mathematics (STEM) education in underprivileged students from local middle schools. Through the Opportunity Program Inc., more than 26,000 at-risk students received discounted or free educational experiences.

The VASC helps to extend Langley's reach into the community through events highlighting NASA. In March, former astronaut Susan Kilrain appeared at NASA Engineering Day, an event filled with activities and hands-on demonstrations. More than 2,000 visitors attended, including Girl Scouts, who were encouraged to hone their engineering and technology skills.

The VASC also celebrated the opening of the new IMAX film "Hubble 3D" in March, with astrophysicist Frank Summers of the Space Science Telescope Institute in Baltimore. The opening highlighted the challenges of a Hubble repair mission and the science behind the stunning discoveries revealed in telescope images.

For the second year running, VASC hosted the Hampton Roads version of Yuri's Night, an annual event in countries around the world. It celebrates the flight of the first human in space and the first space shuttle flight in 1981. More than 1,500 guests attended Yuri's Night, which featured interactive displays, live entertainment, a "Virtusphere" and activities to inspire the next generation of explorers.

Guests at the International Space Day celebration in May experimented with rockets, participated in science demonstrations and held a piece of the moon in their hands.

The VASC also helped NASA celebrate the Summer of Innovation in June with free exhibit admission and hands-on activities for middle schoolers and their families.

Jerry Gammon

A time-lapse view of the Virginia Air & Space Center, Langley's official visitor center.

Agency Functions

NASA Engineering & Safety Center (NESC)

The NESC's mission is to perform value-added independent testing, analysis, and assessments of NASA's high-risk projects to ensure safety and mission success. The independently funded NESC engages proactively to help NASA avoid future problems, with a dedicated team of technical experts that provides objective engineering and safety assessments of critical, high-risk projects. This is the charge of the NESC: Promote an organization dedicated to promoting safety through engineering excellence, unaffected and unbiased by the programs it is evaluating. The NESC is a resource that benefits the programs and organizations within NASA.

Independent Program Assessment Office (IPAO)

IPAO's main role is to enable the independent review of the Agency's programs and select projects at key life-cycle decision points to support approval decisions by the NASA leadership and to ensure mission success. Independent life-cycle reviews provide unbiased and comprehensive assessments of the technical, schedule, and cost and risk posture of proposed and ongoing programs and projects to provide objective advice to NASA's program management councils.

Earth System Science Pathfinder (ESSP) Program

The Earth System Science Pathfinder (ESSP) Program is an innovative approach for addressing Earth science research, providing periodic windows of opportunity to accommodate new scientific priorities. It includes a series of relatively low-to-moderate cost, small-to-medium-sized, competitively selected projects built, tested and launched in a short time interval. This approach gives the program the flexibility to take advantage of opportunities presented by domestic and international cooperative efforts or technical innovation.

Science Office for Mission Assessments

The Science Office for Mission Assessments is an organizational element of NASA's Science Mission Directorate. Its mission is to assist the directorate in the acquisition of Earth and space science missions and instruments through development of Announcement of Opportunity solicitations and technical, management, and cost evaluations of proposals received. The office also leads special studies, independent assessments and reviews, and serves as a principal interface with the NASA Academy of Program/Project and Engineering Leadership in developing and implementing training programs for the Science Mission Directorate.

Recognition Rewards Innovation

Awards and patents mean a lot to a lot of people. They motivate, inspire and encourage. They usually mean we've done something you'll benefit from, too. Whether it's a NASA-inspired spinoff, for use in everyday life, or a technology that lets us continue the mission of exploration and discovery on Earth, in the skies, and in space. It's all about all of us.

Recognitions

• Michael Gilbert, NASA Engineering & Safety Center, received the American Institute of Aeronautics & Astronautics National Engineer of the Year award.

• Karen Jackson, Structural Dynamics Branch, was awarded the rank of Technical Fellow by the American Helicopter Society.

• Natalia Alexandrov, Aeronautics Systems Analysis Branch, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Simon Chung, Independent Program Assessment Office, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Susan Gorton, Aeronautics Research Mission Directorate Projects, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Irene Gregory, Dynamic Systems & Control Branch, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Stanley Smeltzer, CLV Project Implementation Office, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Veer Vatsa, Computational Aerosciences Branch, was awarded the rank of Associate Fellow by the American Institute of Aeronautics & Astronautics.

• Lesa Roe, Center Director, was co-recipient of the Leadership Award from Women in Aerospace.

• Jill Prince, Atmospheric Flight & Entry Systems Branch, received an Achievement Award from Women in Aerospace.

• Jay Brandon, Flight Dynamics Branch, received the AIAA Hampton Roads Section, Engineer of the Year award.

• Christine Belcastro, Dynamic Systems & Control Branch, was awarded the (Virginia) Peninsula Engineers Council, Peninsula Engineer of the Year Award.

• Qamar Shams, Aeronautics Systems Engineering Branch, received the Green Innovation Award for 2010 from the Green Economic Alliance.

• The University of Florida inducted Lesa Roe, Center Director, into the Electrical and Computer Engineering Academy for accomplishments during her career in government.

• Stephen Smith of the Durability, Damage Tolerance & Reliability Branch received the ASTM-International Award of Appreciation for service as chairman of the Threshold Task Group.

• K. Elliott Cramer, Daniel Perey, and William Yost of the Nondestructive Evaluation Sciences Branch were awarded the NASA Government Invention of the Year Award for U.S. Patent No 7,181,942 for Ultrasonic Wire Crimp Inspection Technology.

• Paul Danehy, Advanced Sensing & Optical Measurement Branch, was invited to give a plenary lecture on the "Use of Coherent Anti-Stokes Raman Spectroscopy (CARS) for Temperature and Concentration Measurement at NASA Langley Research Center" at the 9th European Conference on Nonlinear Optical Spectroscopy in Breman, Germany.

• Tony Slaba of the Durability, Damage Tolerance & Reliability Branch was recognized at the International meeting of the Committee on Space Research (COSPAR) with the outstanding paper award for young scientists for "Utilization of CAM, CAF, MAX, and FAX for Space Radiation Analyses using HZETRN."

• Sang Choi and Glen King of the Advanced Materials & Processing Branch received the International SOLAR Industry Award in the Metrology/Test Inline Solution category for "X-Ray Diffraction Characterization Method."

• Brett Bathel, student at University of Virginia; Paul Danehy, Advanced Sensing & Optical Measurement Branch; Jennifer Inman, Advanced Sensing & Optical Measurement Branch; Stephen Jones, Advanced Sensing & Optical Measurement Branch; Chris Ivey, student at Johns Hopkins University; and Chris Goyne, University of Virginia, received a best paper award for "Multiple Velocity Profile Measurements in Hypersonic Flows Using Sequentially-Imaged Fluorescence Tagging," Paper AIAA-2010-1404 at the 48th AIAA Aerospace Sciences Meeting.

• John Davidson, Dynamic Systems and Control Branch, received a best paper award from SAE/IEEE Aerospace Control and Guidance Systems Committee (ACGSC) for his briefing on the Orion Project given at ACGSC meeting in Charlottesville, VA.

• Luis Crespo, Daniel Giesy, and Sean Kenny of the Dynamic Systems and Control Branch received the National Institute of Aerospace's best research publication award for their paper "Reliability-based Analysis and Design via Failure Doman Bounding."

• Jarvis J. Arthur III, Randall Bailey, E. Bruce Jackson, Jim Barnes (ARINC), Lynda Kramer, and Steven P. Williams received the Synthetic and Enhanced Vision Conference, SPIE, best paper award for "Part-task Simulation of Synthetic and Enhanced Vision Concepts for Lunar Landing."

• Lesa Roe was recognized with a Woman of Distinction in Science and Technology award by the YWCA of Newport News.

• Frank Quinto, Subsonic/Transonic Testing Branch, was recognized by the Virginia Air & Space Center for 1000 hours of volunteer service.

Patents

• Donovan Delozier, Kent Watson, John Connell, and Joseph Smith, Jr. received patent 7,723,464 B2 for aromatic/aliphatic diamine derivatives for advanced compositions and polymers.

• Stanley Woodard and Bryant Taylor received patent 7,711,509 B2 for a method of calibrating a fluid-level measurement system.

• Thomas Brooks and William Humphreys, Jr. received patent 7,783,060 B2 for deconvolution methods and systems for the mapping of acoustic sources from phased microphone arrays.

• Kristopher Wise, Cheol Park, Emilie Siochi, Joycelyn Harrison, Peter Lillehei, and Sharon Lowther received patent 7,666,939 B2 for dispersions of carbon nanotubes in polymer matrices.

• Atul Kelkar and Suresh Joshi received patent 7,623,993 B2 for a method and system to perform energy-extraction based active noise control.

• Brian Holloway, Peter Eklund, Michael Smith, Kevin Jordan, and Michelle Shinn received patent 7,692,116 B1 for laser ablation for the synthesis of carbon nanotubes.

See next page

President Honors NASA's Role in Chilean Mine Rescue

NASA employees who helped with the rescue of trapped Chilean miners got a trip to the White House in addition to the satisfaction of a job well done.

President Barack Obama welcomed the NASA team to the Oval Office on Oct. 28 for a ceremony that recognized Americans involved in the rescue.

Langley Played Role

After the White House event, NASA Administrator Charles Bolden and Deputy Administrator Lori Garver presented NASA's Exceptional Achievement Medal to five employees who supported the rescue effort. One of them was engineer Clint Cragg, of the Langley-based NASA Engineering and Safety Center.

"We're greatly honored by the president's recognition of these extraordinary NASA employees who assisted the Chilean miners," Bolden said. "I'm sure they would be the first to tell you they were just doing their jobs and nothing out of the ordinary, but the men and women of NASA do extraordinary things each and every day."

NASA employees visited the mine after discussions with the Chilean government.

NASA/Paul E. Alers

President Obama, center, meets with members of the NASA team in the Oval Office. (From left) Dr. Michael Duncan, Dr. Albert Holland, Dr. James Polk and Langley's Clint Cragg, along with others who traveled to Chile to help. NASA Administrator Charles Bolden is at the far right.

NASA provided technical advice based on the Agency's experience protecting humans in the hostile environment of space.

Recommendations were made on medical care, nutrition, psychological support, and the design of a capsule to extract the miners.

"One of my recommendations was that NASA could help fleshing out some of the requirements for the rescue capsule," said Cragg,

"When I saw the first miner being extracted," he recalled, "I was both happy and very relieved."

For information about NASA's support to the Chilean miner rescue effort, visit: http://www.nasa.gov/news/chile_assistance.html.

Patents *Continued*

• Gilda Miner, Diane Stoakley, Gregory Gaddy, Brent Koplitz, Steven Simpson, Michael Lynch, and Samuel Ruffner received patent 7,758,927 B2 for laser-induced fabrication of metallic interlayers and patterns in polyimide films.

• Paul Danehy and Adrian Dorrington received patent 7,675,619 B2 for a micro-lidar velocity, temperature, density, and concentration sensor.

• Jarvis Arthur, Randall Bailey, Lawrence Prinzel III, Lynda Kramer, and Steven Williams received patent 7,737,867 B2 for multi-modal cockpit interface for improved airport surface operations.

• Adrian Dorrington, Thomas Jones, Paul Danehy, Kent Watson, John Connell, Richard Pappa, and Keith Belvin received patent 7,667,847 B2 for a photogrammetric system and method used in the characterization of a structure.

• Juan Vazquez, Roberto Cano, Brian Jensen, and Erik Weiser received patent 7,541,388 B2 for polyimide foams.

• Tak-kwong Ng and Jeffrey Herath received patent 7,647,543 B2 for a reprogrammable field programmable gate array with integrated system for mitigating effects of single event upsets.

• Anthony Watkins, Bradley Leighty, Donald Oglesby, JoAnne Patry, and Jacqueline Schryer received patent 7,781,366 B2 for sol-gel based oxidation catalyst and coating system using same.

• Anthony Watkins, Bradley Leighty, Donald Oglesby, JoAnne Ingram, and Jacqueline Schryer received patent 7,655,595 B2 for sol-gel based oxidation catalyst and coating system using same.

• Donald Thomsen III received patent 7,649,439 B2 for a flexible thin metal film thermal sensing system.

• Donald Thomsen III and Robert Bryant received patent 7,647,771 B2 for thermally driven piston assembly and position control therefore.

• Brian Stewart received patent 7,760,778 B2 for thin-film evaporative cooling for side-pumped laser.

• John Buckley, William Edwards, Warren Kelliher, and Ingrid Carlberg received patent 7,742,663 B2 for wave energy transmission apparatus for high-temperature environments.

• Yeonjoon Park, Sang Choi, Glen King, James Elliott, and Albert Dimarcantonio received patent 7,769,135 B2 for x-ray diffraction wafer mapping method for rhombohedral super-hetero-epitaxy.

Transonic Dynamics Tunnel: 50 Years of Flutter

Soon after the Transonic Dynamics Tunnel (TDT) opened in early 1960, it was called upon to help solve a serious safety issue — what caused the wings of two Lockheed Electras to snap off in flight?

From that first test to the present, the TDT has made significant contributions to understanding how structures move during flight — behaviors called aeroelasticity and flutter. Aeroelasticity looks at how airflow affects structures in flight. Flutter is a potentially destructive vibration of structures.

A joined wing model in the TDT.

Langley had studied flutter since the 1940s in small tunnels. As aircraft began to fly faster, researchers realized that a larger tunnel with sustained transonic (just below, at, and just above the speed of sound) capabilities was needed to gain a better understanding of the phenomena.

Langley engineer Arthur Regier had an idea for such a tunnel. Regier's design was accepted, but then as now, Langley's budget for new construction was limited. A decision was made to decommission the 19-Foot Pressure Tunnel, use as much of the structure as possible and build the new Transonic Dynamics Tunnel on the site.

The Electra test in the new TDT was an important one. Lockheed engineers brought a model of their new airplane to the tunnel. They and the TDT staff, with assistance from Boeing and Federal Aviation Administration (FAA) engineers, began to examine the flutter characteristics of the aircraft. The tests determined that destructive flutter began following damage to the beams that attached the engines to the wing. The flutter problem was solved by modifying the attachment beams.

From that early first test to the present the TDT has made significant contributions to understanding the aeroelastic characteristics of a variety of airplanes, helicopters, and space launch vehicles. While the TDT began by studying aircraft, it has also looked at Apollo and its Saturn rocket, the space shuttle, and Mars robotic explorers.

With upgrades to test visualization and data recording, the staff of the Transonic Dynamics Tunnel continue to make significant contributions to the understanding of aeroelasticity and to keep aircraft and spacecraft flying safely.

Woodrow Whitlow, NASA's Associate Administrator for Mission Support and former TDT researcher, speaks at the TDT 50th celebration.

See http://aeroelasticity.larc.nasa.gov/index.php/facilities/transonic-dynamics-tunnel/ for more information about Langley's aeroelasticity research.

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Telephone: (757) 864-6300

Web site: ..... http://www.nasa.gov/centers/langley

Facebook: ..... http://tinyurl.com/langleyfacebook

Twitter: ..... http://twitter.com/#!/nasa_langley

NASA.....www.nasa.gov

LaRC ..... www.nasa.gov/centers/langley/home/index.html

LaRC Exploration ..... www.nasa.gov/centers/langley/exploration/index.html

LaRC Aero ..... www.nasa.gov/centers/langley/aeronautics/index.html

LaRC Science ..... www.nasa.gov/centers/langley/science/index.html

From Laboratory to Marketplace.....www.nasa.gov/centers/langley/business/index.html

LaRC Education ..... www.nasa.gov/centers/langley/education/index.html

LaRC Traveling Exhibits.....www.nasa.gov/centers/langley/news/exhibits.html

LaRC Speakers Bureau.....http://www.nasa.gov/centers/langley/news/speakers.html

Virginia Air & Space Center .....www.vasc.org

The mid-Atlantic seaboard as seen from NASA's Earth Observatory satellite. The Chesapeake Bay and its tributaries are seen in the middle of the image.

I believe Langley's best days are ahead of us. With our workforce, we can enable a future … where advancements in air mobility move goods and people, point-to-point, anywhere in the nation and around the world … where climate change concerns are resolved … and where space is open to everyone."

Lesa B. Roe
Center Director, NASA Langley Research Center

National Aeronautics and Space Administration
Langley Research Center
Hampton, VA 23681

www.nasa.gov

NP-2010-10-310-LaRC