

National Aeronautics and Space Administration



# SPINOFF



2012

## Health and Medicine

1. Water Treatment Technologies Inspire Healthy Beverages (MN)
2. Dietary Formulas Fortify Antioxidant Supplements (TX)
3. Rovers Pave the Way for Hospital Robots (MA)
4. Dry Electrodes Facilitate Remote Health Monitoring (VA)
5. Telescope Innovations Improve Speed, Accuracy of Eye Surgery (CA)
6. Superconductors Enable Lower Cost MRI Systems (OH)

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8. Shuttle Repair Tools Automate Vehicle Maintenance (FL)
9. Pressure-Sensitive Paints Advance Rotorcraft Design Testing (OH)
10. Speech Recognition Interfaces Improve Flight Safety (NY)
11. Polymers Advance Heat Management Materials for Vehicles (NY)
12. Wireless Sensors Pinpoint Rotorcraft Troubles (AZ)

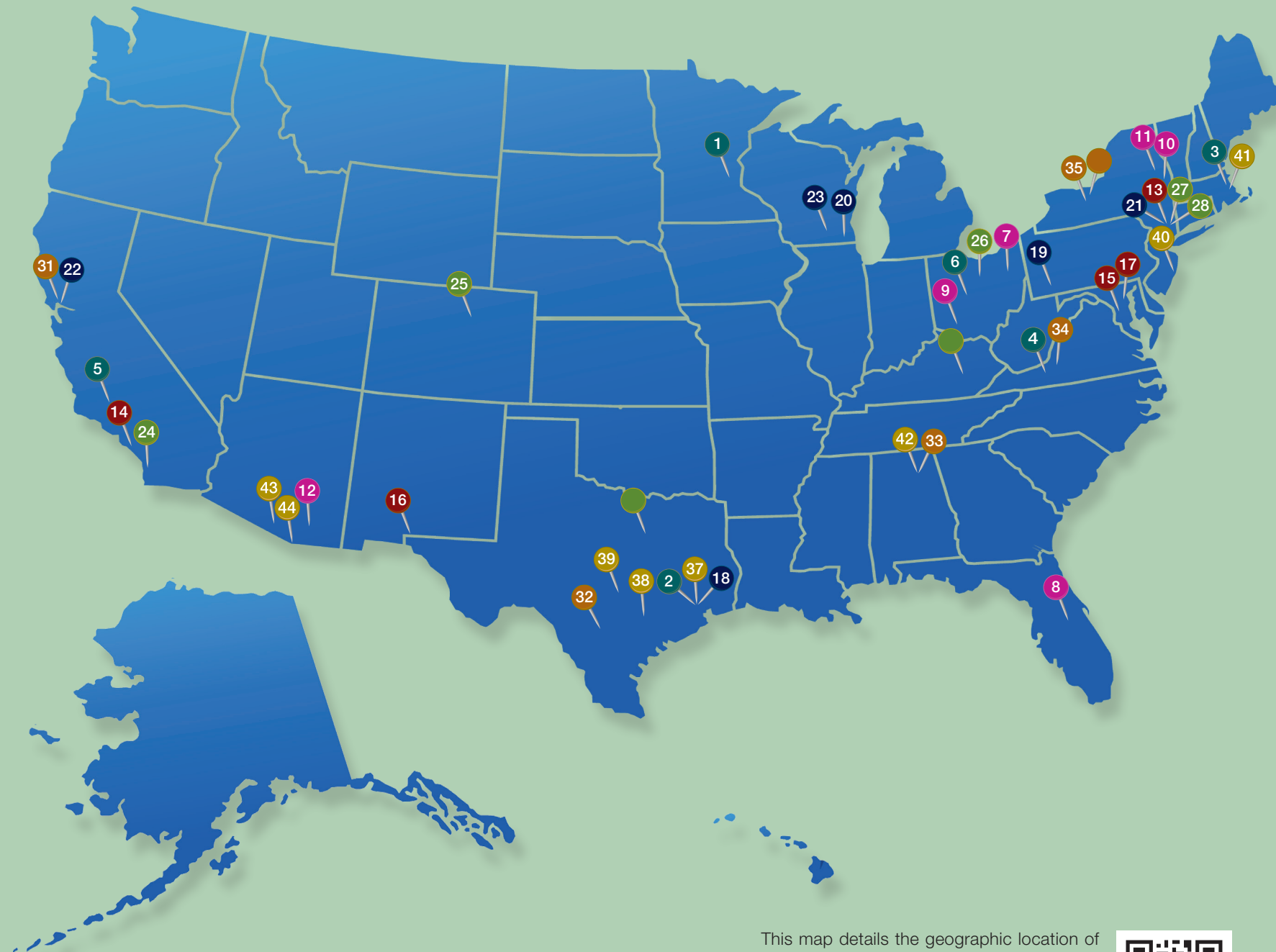
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# NASA Spinoff Technology Across the Nation



This map details the geographic location of each company that appears in 2012. For a deeper look at how spinoffs have benefited your state and local economy, scan this code.



## Energy and Environment

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## Health and Medicine



While NASA takes us farther into the universe every day, it also makes sure its innovations benefit us here on Earth. NASA *Spinoff* highlights the Agency's most significant research and development activities and the successful transfer of NASA technology, showcasing the cutting-edge research being done by the Nation's top technologists and the practical benefits that come back down to Earth in the form of tangible products that make our lives better. Since 1976, *Spinoff* has profiled more than 1,800 of the most compelling of these technologies, annually featuring the best and brightest of partnerships and innovations in the fields of health and medicine, transportation, public safety, consumer goods, energy and environment, information technology, and industrial productivity.

1

### Water Treatment Technologies Inspire Healthy Beverages

Mike Johnson, a former technician at Johnson Space Center, drew on his expertise as a wastewater engineer to create a line of kombucha-based probiotic drinks. Unpeeled Inc., based in Minneapolis-St. Paul, Minnesota, employs 12 people and has sold more than 6 million units of its NASA-inspired beverage.



3

### Rovers Pave the Way for Hospital Robots

Before Curiosity came Spirit and Opportunity. And before Spirit and Opportunity came Pathfinder, Sojourner, and the Viking landers. Over the years, a host of Mars missions and programs have built on one another, spurring technology advancements that have led to the impressive collection of Mars information and images that we have today.

The Jet Propulsion Laboratory provided funding for the Massachusetts Institute of Technology to develop capabilities for robotics like Rocky 7, a prototype used to research navigation and sampling technology for Mars. After developing the operating system for the robot, Daniel Theobald started working at Cambridge, Massachusetts-based Vecna Technologies.

"I thought, if we can successfully have a robot operate on Mars for an extended period of time, then we should have robots on Earth, providing value on a daily basis," he says.

Today, Vecna's QC Bot incorporates systems based on the NASA work and is being used to ease logistics at hospitals. QC Bot can be used for everything from delivering medications or taking out the trash, to ushering patients to their appointments. A configurable touch screen allows hospital staff and patients to interact with the robot, and it can be used for completing bedside registration as well as capturing vital signs. The technology has contributed to 20 new jobs at the company.







2

## Dietary Formulas Fortify Antioxidant Supplements

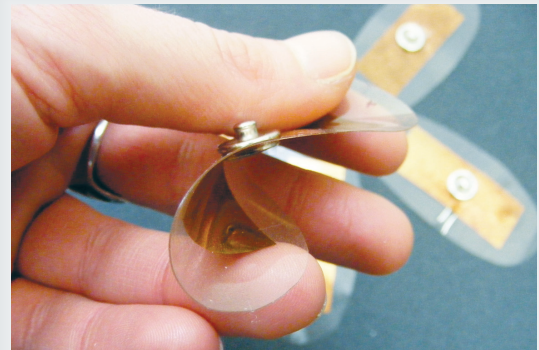
As NASA plans for long missions, it explores ways to provide astronauts with nutrition equivalent to fresh produce. Johnson Space Center entered into a Space Act Agreement with Houston-based AmeriSciences LP to develop a multivitamin and other supplements for astronaut health. By 2011, the company commercialized its NASA-derived products in multivitamins, antioxidants, and omega-3 fatty acids.



4

## Dry Electrodes Facilitate Remote Health Monitoring

Johnson Space Center collaborated with Blacksburg, Virginia-based NanoSonic Inc. through the SBIR program to devise a sensor to replace the traditional electrodes used for an electrocardiogram in space. In 2011, NanoSonic started marketing the dry electrodes as well as an EKGear Sensor Shirt, which is being considered for use in hospital garments, athletic apparel, and dive suits.



5

## Telescope Innovations Improve Speed, Accuracy of Eye Surgery

To polish the Webb telescope mirrors, Goddard Space Flight Center enlisted the help of several contractors. WaveFront Sciences, later acquired and renamed Abbott Medical Optics, developed a system for testing the mirrors. The Santa Ana, California-based company now offers a laser vision product, enhanced by the telescope innovations, to measure a patient's eye and create a map for the treatment.



6

## Superconductors Enable Lower Cost MRI Systems

Hyper Tech Research, a Columbus, Ohio-based company, received funding from Glenn Research Center's SBIR program to investigate a magnesium diboride ( $MgB_2$ ) superconductor for future aircraft propulsion systems. The company advanced  $MgB_2$  to a point where it is now used in prototype MRI devices, has been able to add 16 employees, and has generated \$3 million in revenue.







## Transportation



7

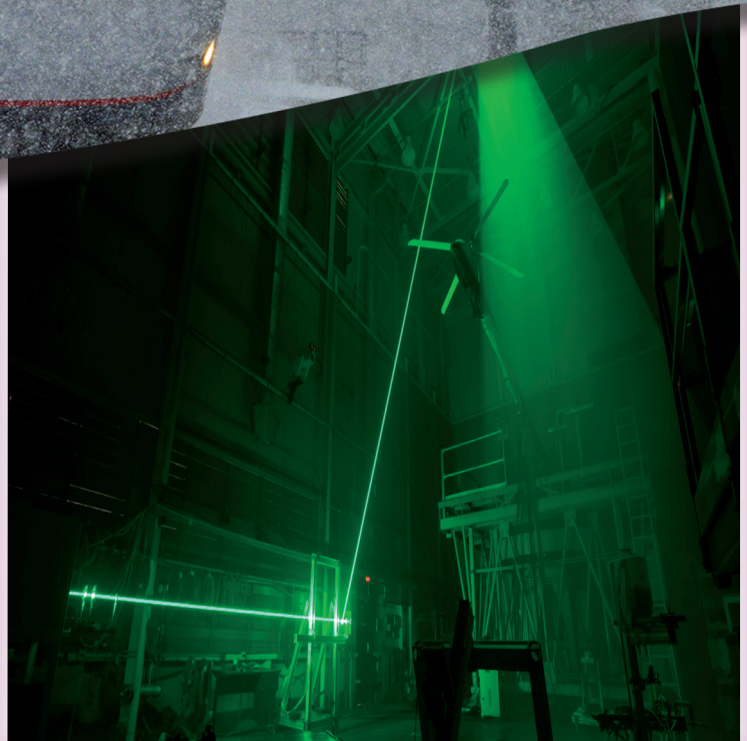
### Anti-Icing Formulas Prevent Train Delays

Because an airplane must be snow- and ice-free to fly safely, researchers at Ames Research Center devised a solution that prevented ice from sticking to the surface. Midwest Industrial Supply Inc. of Canton, Ohio, licensed the technology for use in anti-icing products for train tracks and switches. Now the products increase the company's revenue by \$300,000-\$600,000 a year.

9

### Pressure-Sensitive Paints Advance Rotorcraft Design Testing

Partnering with Langley Research Center through the SBIR program, Innovative Scientific Solutions Inc. of Dayton, Ohio, developed enhanced pressure-sensitive paint technology for gathering essential aerodynamic data from high-speed, unstable surfaces such as rotorcraft blades. The efficient, cost-effective spinoff innovation has generated approximately \$200,000 in revenue for the company.



8

### Shuttle Repair Tools Automate Vehicle Maintenance

When paperwork generated by shuttle repairs got out of hand, Kennedy Space Center developed software that would streamline the maintenance, repair, and overhaul (MRO) process. The result was SMART, a tool that automates MRO, cutting repair times by 45 percent. Orlando, Florida-based Diversified Industries Inc. licensed SMART and now offers it commercially.





10

### Speech Recognition Interfaces Improve Flight Safety

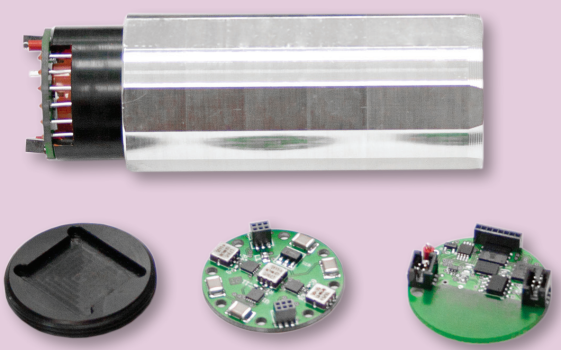
Entering a flight plan into a GPS is time-consuming and poses a safety hazard for pilots. VoiceFlight Systems LLC, in Troy, New York, created a speech recognition interface to replace manual inputs. With support from an SBIR contract from Langley Research Center, the VSF101 became the first Federal Aviation Administration-certified speech recognition product for use in civilian aircraft.



12

### Wireless Sensors Pinpoint Rotorcraft Troubles

With the help of SBIR contracts from Glenn Research Center, Tucson, Arizona-based Ridgetop Group Inc. has pioneered wireless sensors that can function inside of rotorcraft transmissions. The sensors have a large number of applications, and the data they provide can improve mean time to repair by as much as 50 percent.



11

### Polymers Advance Heat Management Materials for Vehicles

For 6 years prior to the retirement of the Space Shuttle Program, the shuttles carried an onboard repair kit with a tool for emergency use: two tubes of NOAX, or “good goo,” as some people called it. NOAX flew on all 22 flights following the Columbia accident, and was designed to repair damage that occurred on the exterior of the shuttle.

While NASA funded the full-scale development of NOAX, the sealant was actually invented by Alliant Techsystems Inc. (ATK). Under NASA funding, ATK contracted with Starfire Systems Inc., a manufacturer of polymer-to-ceramic technology based in Schenectady, New York, to supply the unique polymer material that was incorporated into NOAX. Called SMP-10, Starfire’s polymer was designed to convert into a ceramic at high temperatures.

According to Darren Welson, director of technology at Starfire, SMP-10 was formulated and processed for incorporation into NOAX, which laid the groundwork for Starfire to achieve a repeatable process for a reliable product.

In looking for ways to make SMP-10 less expensive for commercial use, Starfire developed StarPCS for high temperature applications on Earth. The company now manufactures a family of NASA-derived heat management products for military, aerospace, aviation, and automotive markets.







## Public Safety



### 13 Ultrasonic Detectors Safely Identify Dangerous, Costly Leaks

To allow inspectors to scan the space shuttle's hydrogen fuel systems from a safe distance, Kennedy Space Center engineers developed a long-range attachment for an ultrasonic detector. Elmsford, New York-based UE Systems licensed the NASA invention, which allows workers to safely and accurately pinpoint leaks in factories and other industrial applications, providing savings in the millions of dollars.

### 14 Detectors Ensure Function, Safety of Aircraft Wiring

To help inspect electrical bundles and wires on the space shuttle, Pedro Medelius at Kennedy Space Center invented the standing wave reflectometer. Corona, California-based Eclipse International licensed the technology, which is now used on wiring in aircraft, submarines, sea vessels, and helicopters. The company has grown to 30 employees and the technology has saved more than \$2 million on development costs.

15

### Emergency Systems Save Tens of Thousands of Lives

Shortly before midnight on September 21st, 2010, the small fishing boat *Ebby Luz* started taking on water. In immediate danger and 8 miles from the shore, its crew activated an emergency beacon that began transmitting their distress signal, identity, and location. Within minutes, the Coast Guard was notified and launched a helicopter to the coordinates received from the alert. Even though the vessel had already sunk by the time help arrived, and despite it being pitch dark, the rescuers were able to locate and save both crew members from the water.

These two sailors were among the 295 people in the United States saved through the NASA-developed Search and Rescue Satellite Aided Tracking (SARSAT) system in 2010. Since SARSAT was introduced in 1982, nearly 7,000 lives have been saved in the United States alone. Worldwide, the international effort is known as Cospas-Sarsat, and over 30,000 people have been rescued as a result of these emergency beacons.

Techno-Sciences Inc., of Beltsville, Maryland, is a company that has been involved with the ground station component of the system from its earliest days. As each generation of SARSAT has been developed by NASA, commercial partners like TSi have contributed hardware and technology to support development and ongoing operations. This has help put TSi in position to compete in the global market for search and rescue components.







16

### Oxygen Assessments Ensure Safer Medical Devices

A team at White Sands Test Facility developed a test method to evaluate fire hazards in oxygen-enriched environments. Wendell Hull and Associates, located in Las Cruces, New Mexico, entered a Space Act Agreement with NASA and now provides services including fire and explosion investigations, oxygen testing and training, and accident reconstruction and forensic engineering.



17

### Collaborative Platforms Aid Emergency Decision Making

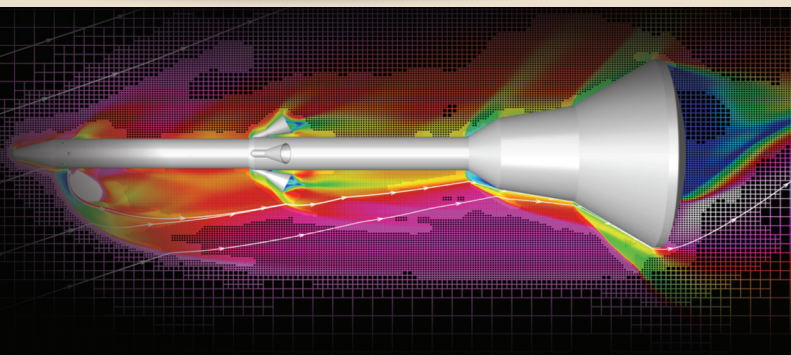
Though NASA collects a great deal of real-time data, it cannot always be put to use in a single platform. Baltimore-based StormCenter Inc. has partnered with NASA Headquarters to make real-time collaboration a reality, greatly enhancing emergency decision-making efforts by public authorities.







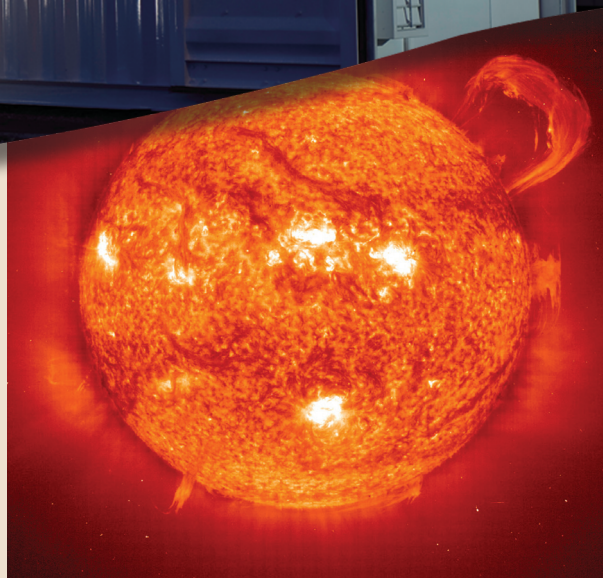
## Information Technology



31

### Simulation Packages Expand Aircraft Design Options

In 2001, NASA released a new approach to computational fluid dynamics that allows users to perform automated analysis on complex vehicle designs. In 2010, Palo Alto, California-based Desktop Aeronautics acquired a license from Ames Research Center to sell the technology. Today, the product assists organizations in the design of subsonic aircraft, space planes, spacecraft, and high speed commercial jets.



33

### Behavior Prediction Tools Strengthen Nanoelectronics

NASA's electronics must resist the effects of extreme temperature and radiation. Huntsville, Alabama-based CFD Research Corporation received funding from Marshall Space Flight Center's SBIR program to refine software to predict the behavior of electronics in space. Now used by the Department of Defense, nuclear laboratories, and commercial satellite designers, the software has generated approximately \$2 million in revenue.



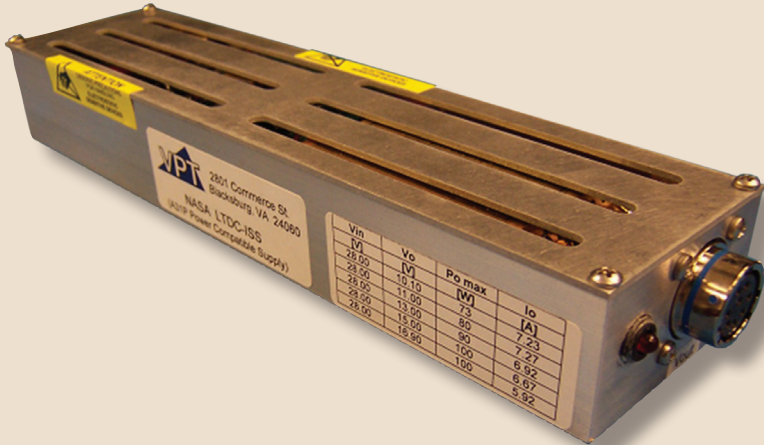
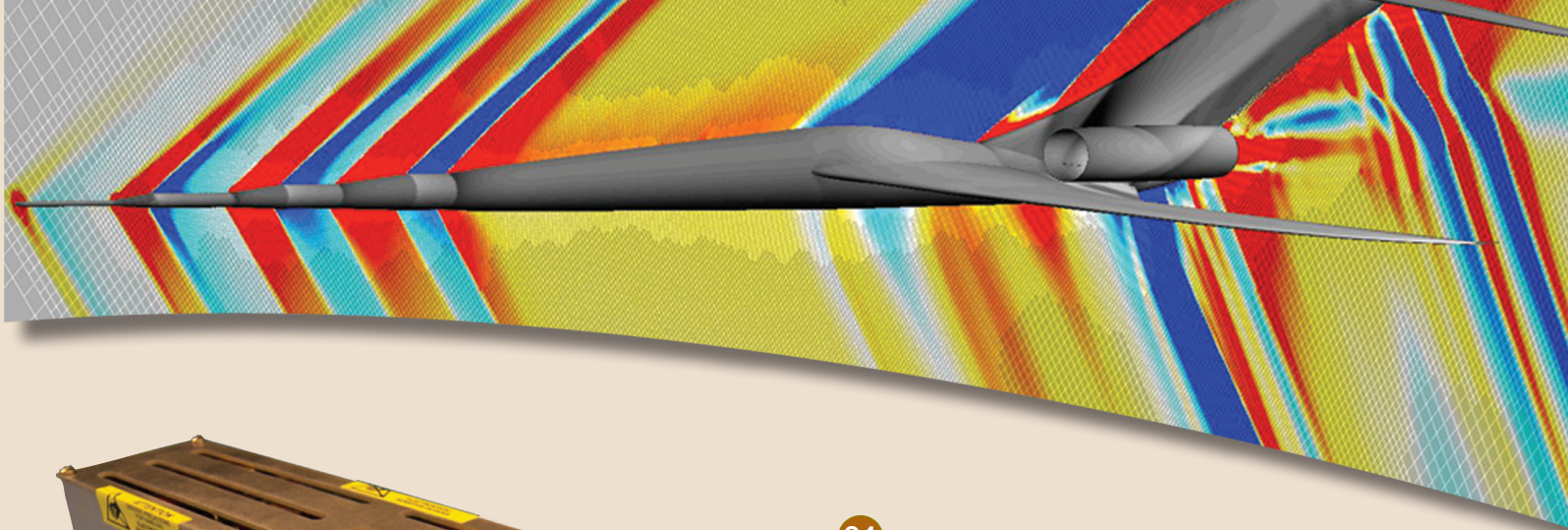
32

### Web Solutions Inspire Cloud Computing Software

In 2008, a NASA effort to standardize its websites inspired a breakthrough in cloud computing technology. Cloud computing is the delivery of software, processing power, and storage over the Internet. Whether these resources are as ordinary as a library of music files or as complex as a network of supercomputers, cloud computing enables an end user to control them remotely and simply. The Agency decided to develop its own open source platform for cloud computing and teamed up with San Antonio, Texas-based Rackspace Inc. to complete the infrastructure.

The OpenStack project was announced in July 2010. As open source software, OpenStack has attracted a very broad community: nearly 2,500 independent developers and 150 companies are a part of it including such giants as AT&T, HP, Cisco, Dell, and Intel. The innovation has spurred the growth of an entire industry in services that has already attracted millions in investment and is currently generating hundreds of millions in revenue.

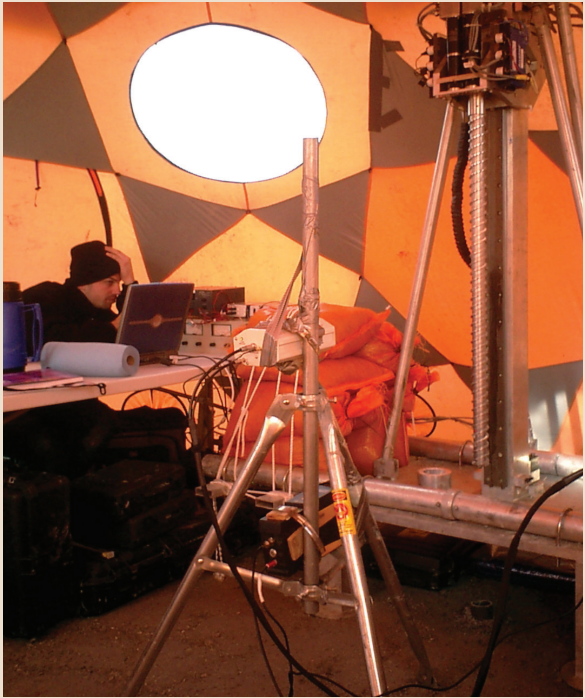




34

### Power Converters Secure Electronics in Harsh Environments

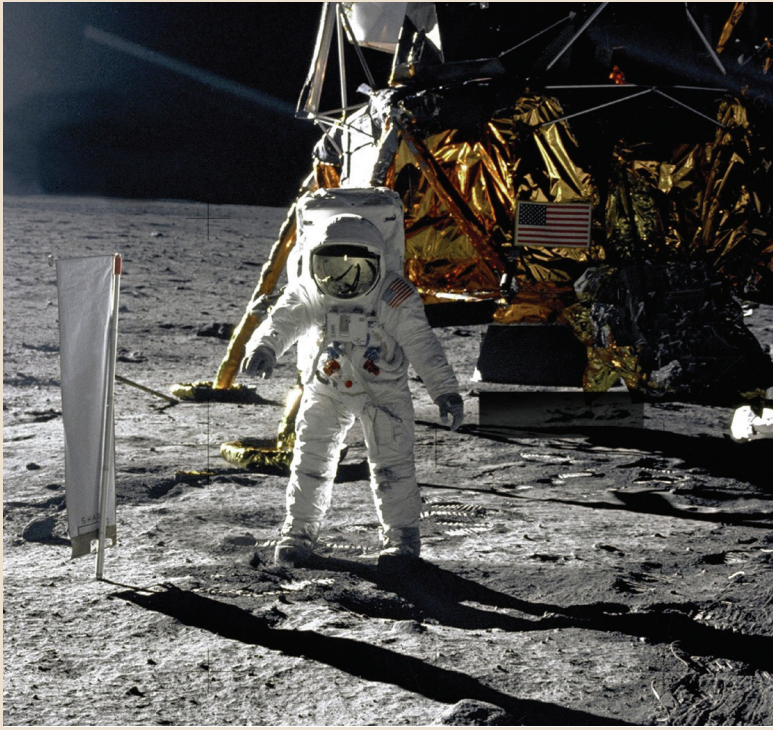
In order to harden power converters for the rigors of space, NASA awarded multiple SBIR contracts to Blacksburg, Virginia-based VPT Inc. The resulting hybrid DC-DC converters have proven valuable in aerospace applications, and as a result the company has generated millions in revenue from the product line and created four high-tech jobs to handle production.



35

### Diagnostics Tools Identify Faults Prior to Failure

Through the SBIR program, Rochester, New York-based Impact Technologies LLC collaborated with Ames Research Center to commercialize the Center's Hybrid Diagnostic Engine, or HyDE, software. The fault-detecting program is now incorporated into a software suite that identifies potential faults early in the design phase of systems ranging from printers to vehicles and robots, saving time and money.



36

### Archiving Innovations Preserve Essential Historical Records

The Apollo 11 mission left on the Moon a silicon disc inscribed with microscopic recreations of messages from 73 countries. NanoArk Corporation of Fairport, New York, built on that NASA technology to develop a fire- and water-resistant archiving innovation that provides cost savings and security in preserving documents. Since its launch, NanoArk has grown from 2 to 10 employees.





## Energy and Environment



24

### Microradiometers Reveal Ocean Health, Climate Change

Ocean color can reveal a lot of information about the health of the ocean and, in turn, the health of our planet. NASA's Coastal Zone Color Scanner, launched in 1978, was the first ocean color instrument flown on a spacecraft. Since then, the Agency's ocean color research capabilities have become increasingly sophisticated. NASA's suite of satellite technology provides sweeping, global information on ocean color on a scale unattainable by any other means.

To validate and calibrate the satellites, researchers must also gather data at sea level. Partnering with Goddard Space Flight Center through the SBIR program, Biospherical Instruments Inc. of San Diego created modular radiometer instruments that allow scientists to customize the technology for their research needs. A narrow tube shorter in length than a standard pencil, each microradiometer contains light and temperature sensors and was designed with lower cost, smaller size, and increased adaptability in mind. The devices can be clustered into customized arrays to meet a range of data-gathering needs.

The spinoff is now used to monitor the planet's oceans, climate change, and more, and the company has garnered more than \$2 million in contracts thanks to its NASA collaboration.



25

### Sensors Enable Plants to Text Message Farmers

BioServe Space Technologies—a nonprofit, NASA-sponsored research partnership center—developed a leaf sensor that can monitor plants using electrical pulses, allowing anyone from astronauts to farmers to measure plant water levels directly. Berthoud, Colorado-based AgriHouse Brands Ltd. has commercialized the technology, which allows “thirsty” plants to send text messages to farmers asking for more water.

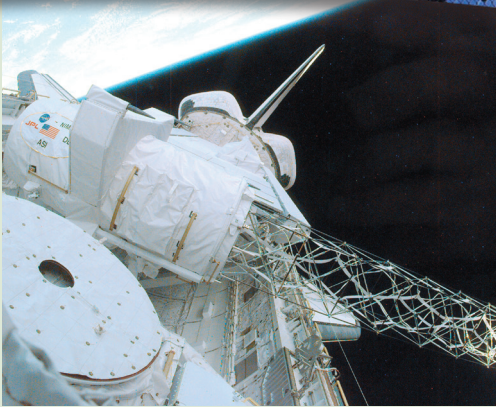


26

### Efficient Cells Cut the Cost of Solar Power

Glenn Research Center engineer Bernard Sater spent his spare time developing a solar concentrator that would use less silicon, making solar arrays cheaper. After retiring from NASA, Sater and his son formed Oberlin, Ohio-based GreenField Solar and, under a Space Act Agreement with Glenn, moved the technology toward commercialization. GreenField Solar now employs 30 people thanks to its NASA partnership.





27

### Shuttle Topography Data Inform Solar Power Analysis

In 2000, the Jet Propulsion Laboratory spearheaded the Shuttle Radar Topography Mission, which created a high-detail global elevation map. The data sets were later processed to produce shading models, which are now part of New York City-based Locus Energy LLC's commercial offerings. Locus Energy's solar power prediction packages help companies save millions of dollars in costs by avoiding expensive hardware.



28

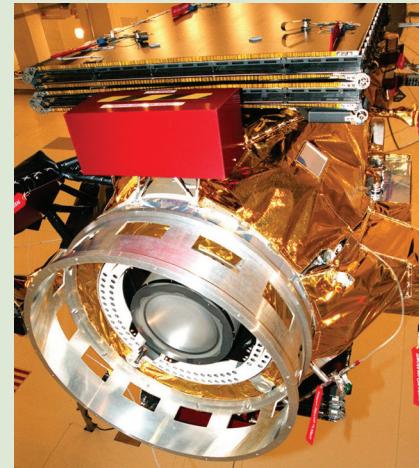
### Photocatalytic Solutions Create Self-Cleaning Surfaces

A Stennis Space Center researcher investigating the effectiveness of photocatalytic materials for keeping the Center's buildings free of grime turned to a solution created by PURETi Inc. of New York City. Testing proved successful, and NASA and the company now share a Dual Use Technology partnership. PURETi's coatings keep surfaces clean and purify surrounding air, eliminating pollution, odors, and microbes.

29

### Concentrators Enhance Solar Power Systems

Glenn Research Center and Fort Worth, Texas-based Entech Solar partnered through the SBIR program to adapt Entech's solar concentrator. Soon after developing the Solar Concentrator Array with Refractive Linear Element Technology, Entech and NASA worked on a version called the Stretched Lens Array (SLA). Recently, Entech incorporated elements from the SLA into a solar concentrator for Earth applications.



30

### Innovative Coatings Potentially Lower Facility Maintenance Costs

Through extensive testing at Stennis Space Center, Nanocepts Inc. of Lexington, Kentucky, received key validation of the effectiveness of its photocatalytic coatings. Now a NASA Dual Use Technology partner, the company's commercial coatings offer unique environmental and medical benefits, and their self-cleaning properties help limit grime buildup on buildings.





## Consumer Goods



18

### Space-Inspired Trailers Encourage Exploration on Earth

Architect Garret Finney joined Johnson Space Center’s Habitability Design Center to work on creating comfortable, efficiently designed crew quarters for the ISS. Drawing directly on that experience, Finney founded Houston-based Cricket and set about creating unique, versatile recreational trailers that incorporate space habitat principles and features.



19

### Ultra-Thin Coatings Beautify Art

Early in the space program, Johnson Space Center developed a vacuum-deposition method for applying ultra-thin coatings of metal to substances. The technology spun off into commercial applications, such as the manufacture of dichroic glass. Jan Lewczenko, owner of Mount Pleasant, Pennsylvania-based JL Crystal Artistry LLC makes use of dichroic glass in his crystal sculptures.

20

### Spacesuit Materials Add Comfort to Undergarments

Phase change materials (PCMs) were one of the technologies NASA used to help astronauts maintain a “just right” temperature in their space gloves. To incorporate PCMs in spacesuit fabrics, Johnson Space Center collaborated with Outlast Technologies Inc. In 2011, Jockey International, headquartered in Kenosha, Wisconsin, released a line of men’s and women’s undergarments incorporating the NASA technology.







21

### Gigapixel Images Connect Sports Teams with Fans

Technology developed at Ames Research Center to take high-resolution imagery on Mars is now being used in baseball stadiums across the country. New York City-based Major League Baseball Advanced Media LP customized the platform to accommodate in-game shots that capture nearly the whole stadium. Fans navigate the photos online and tag themselves and their friends using social media tools.



23

### Elemental Scanning Devices Authenticate Works of Art

To better detect aluminum compounds, Marshall Space Flight Center partnered with KeyMaster Inc. (later acquired by Madison, Wisconsin-based Bruker AXS Inc.) to develop a vacuum pump system that could be attached to X-ray fluorescence (XRF) scanners. The resulting technology greatly expanded XRF scanner capabilities, and hundreds of museums now use them to authenticate artifacts and works of art.

22

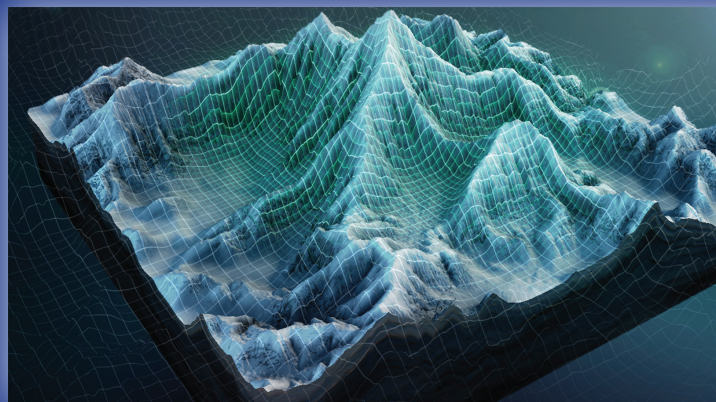
### Satellite Maps Deliver More Realistic Gaming

Terra, the flagship of NASA's Earth Observing System, studies a sweeping set of the planet's characteristics. Included in the satellite is the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). The instrument provides the next generation in remote sensing imaging capabilities.

"The ASTER Global Digital Elevation Map is the most complete global topographic data set freely available to the public," says Michael Abrams, a science team leader at the Jet Propulsion Laboratory. "In the two and a half years since we released it, we have distributed millions of 1 by 1 degree tiles to users all over the world."

One of those beneficiaries is Redwood City, California-based Electronic Arts (EA) Inc. The company is one of the largest video game companies in the world, and in 2009 it began production on Super Snowcross (SSX), the latest in its series of snowboarding games. Instead of using in-house software to create its own imaginary mountain terrains, engineers used ASTER to replicate the topography of 28 real-world mountains.

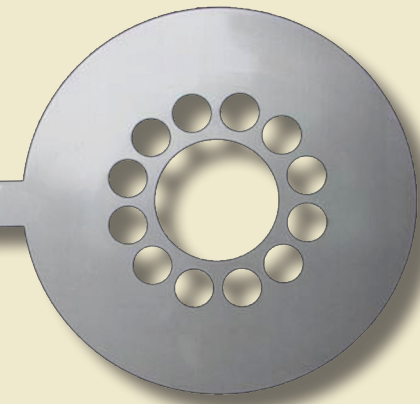
While the overall look and feel of the mountains is realistic, EA added all of the flair, obstacles, and powerups one typically finds in an action game, as well as iconic landmarks such as the Great Wall of China to add interest. Says Todd Batty, producer and creative director of SSX, "Players experience the best of both worlds: everything has an air of authenticity because the base of the data is straight from satellites, but they also get larger than life gameplay."





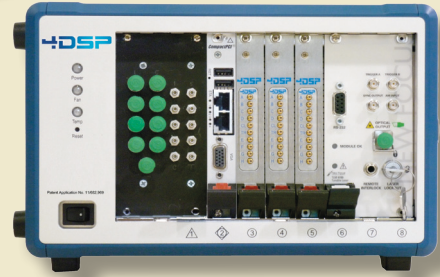


## Industrial Productivity



### 37 Meter Designs Reduce Operation Costs for Industry

Marshall Space Flight Center collaborated with Quality Monitoring and Control (QMC) of Humble, Texas, through a Space Act Agreement to design a balanced flow meter for the Space Shuttle Program. QMC founded APlus-QMC LLC to commercialize the technology, which has contributed to 100 new jobs, approximately \$250,000 in yearly sales, and saved customers an estimated \$10 million.



### 39 Fiber Optics Deliver Real-Time Structural Monitoring

To alter the shape of aircraft wings during flight, researchers at Dryden Flight Research Center worked on a fiber optic sensor system with Austin-based 4DSP LLC. The company has since commercialized a new fiber optic system for monitoring applications in health and medicine, oil and gas, and transportation, increasing company revenues by 60 percent.



### 38 Commercial Platforms Allow Affordable Space Research

At an altitude of about 240 miles, its orbital path carries it over 90 percent of the Earth's population. Its crew experience 16 sunrises and 16 sunsets every 24 hours. A unique feat of engineering, the International Space Station (ISS) also represents the most remarkable platform for scientific research ever devised.

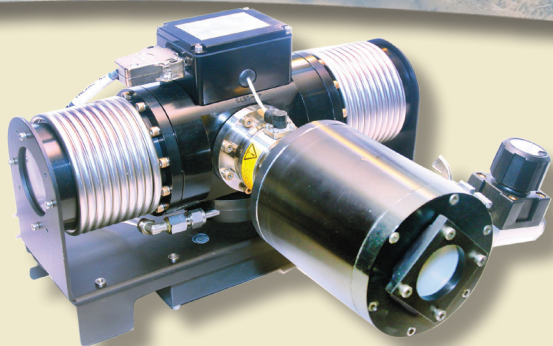
To help realize the potential of the US National Laboratory on the ISS, NASA Headquarters partnered with NanoRacks LLC of Houston through a Space Act Agreement to provide a cost-effective, versatile system for facilitating space-based research. NanoRack's platforms have allowed major research institutions and even high schools to conduct experiments on the ISS—expanding the scope of the commercial space industry.



### 40 Camera Systems Rapidly Scan Large Structures

Needing a method to quickly scan large structures like an aircraft wing, Langley Research Center developed the line scanning thermography (LST) system. LST works in tandem with a moving infrared camera to capture how a material responds to changes in temperature. Princeton Junction, New Jersey-based MISTRAS Group Inc. now licenses the technology and uses it in power stations and industrial plants.

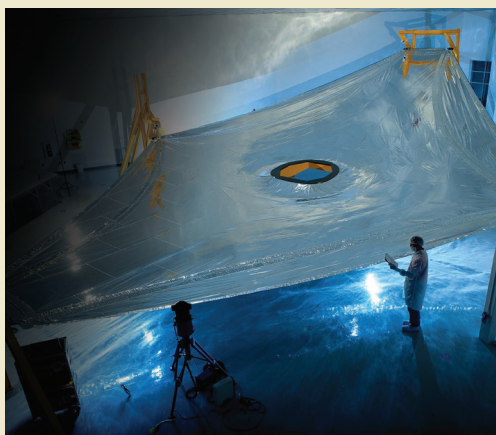




41

### **Terahertz Lasers Reveal Information for 3D Images**

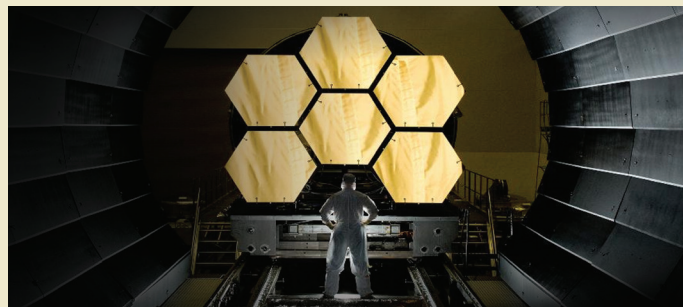
When Kennedy Space Center started looking for new capabilities to inspect the thermal materials for future space vehicles, it solicited proposals through the STTR program. NASA worked with Boston-based LongWave Photonics LLC on a source of terahertz radiation called the quantum cascade laser (QCL). By 2011, LongWave started selling the Easy QCL to academic, industrial, and government researchers.



42

### **Thin Films Protect Electronics from Heat and Radiation**

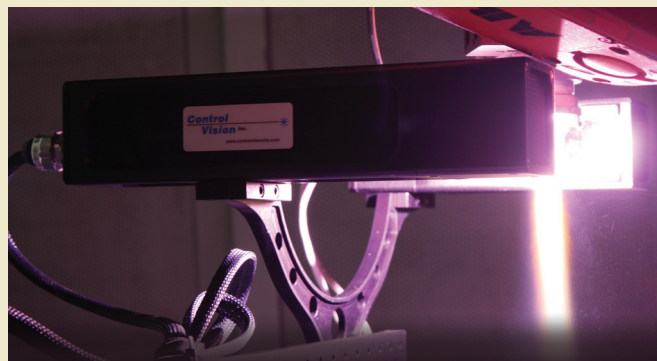
While Anne St. Clair worked on high performance polyimides at Langley Research Center, she noticed that some of the films were nearly colorless. The polyimides became known as LaRC-CP1 and LaRC-CP2, and were licensed by NeXolve Corporation, based in Huntsville, Alabama. Today, NeXolve provides polyimide film products to commercial customers for spacecraft, telescopes, and circuit boards.



43

### **Interferometers Sharpen Measurements for Better Telescopes**

NASA worked with 4D Vision Technology—later acquired by Tucson, Arizona-based 4D Technology Corporation—to develop interferometers that could test large space mirrors. 4D created dynamic interferometry and enhanced the technology for optics, astronomy, aerospace, data storage, university research, manufacturing, and medical industries. The company has grown from 4 employees to more than 30.



44

### **Vision Systems Illuminate Industrial Processes**

To ensure quality results from important manufacturing processes, Marshall Space Flight Center partnered with Control Vision Inc. of Sahuarita, Arizona, to create video sensor systems capable of imaging high-temperature, high-brightness processes like laser welding and plasma spray. The company's resulting commercial products help manufacturers maintain quality control and can be used to control processes such as additive manufacturing.



# 44...

For 2012, NASA's annual *Spinoff* publication unveils the stories behind 44 innovative NASA technologies now used on Earth. Starting with the technologies' origins in Agency missions to their transfer to the public in the form of beneficial commercial products, these spinoffs show how NASA technology saves lives, enhances our quality of life, reduces costs, creates jobs, and increases revenue. But that is not all you will find in *Spinoff* 2012.



## SPINOFFS IN MANUFACTURING

Over the years, *Spinoff* has documented more than 350 NASA technologies that have transferred from the Agency to enhance the Nation's industrial productivity. From innovative manufacturing techniques to materials that allow for entirely new structures, higher performance electronics, and improved energy efficiency—these spinoffs have created hundreds of jobs while ensuring that American companies remain world leaders across industries. Read more in this special section in *Spinoff* 2012.

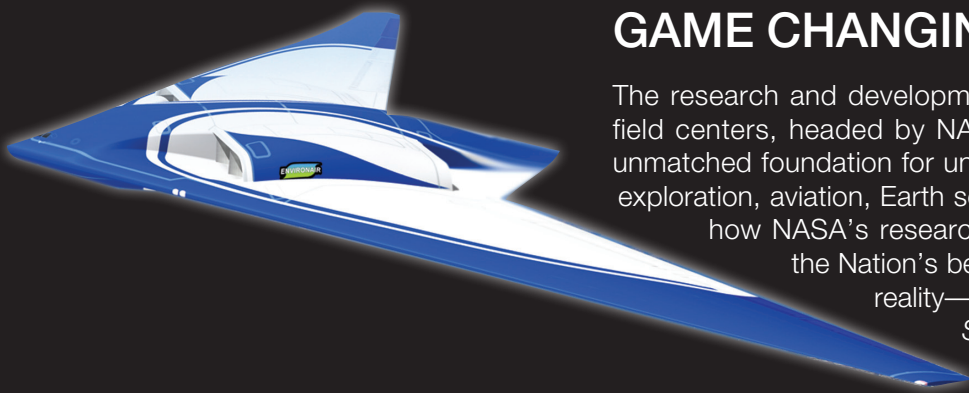
## NASA GOES BACK TO SCHOOL

To ensure the United States stays at the forefront of global innovation, NASA drives efforts to inspire and educate the next generation of inventors and problem solvers. The latest programs and activities from NASA's Office of Education promote science, technology, engineering, and math to students of all ages. Learn more about NASA's efforts to engage students in *Spinoff* 2012.



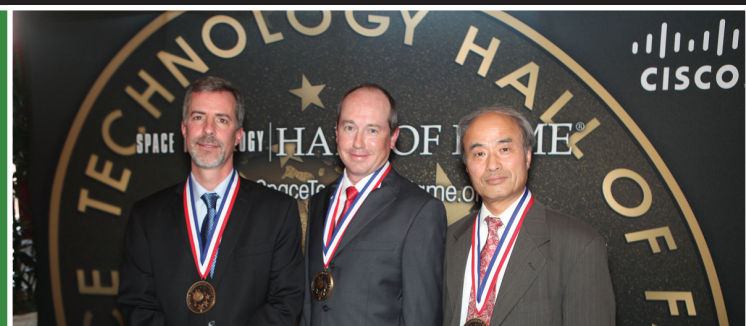
## GAME CHANGING R&D

The research and development that takes place across NASA's 10 field centers, headed by NASA's mission directorates, provides an unmatched foundation for unprecedented accomplishments in space exploration, aviation, Earth science, astrobiology, and more. Discover how NASA's research and development moves the ideas of the Nation's best and brightest minds from possibility to reality—and sets the stage for future spinoffs—in *Spinoff* 2012.



## AND THE WINNER IS...

NASA creates many technologies that are honored as remarkable innovations in their fields, receiving awards from industry, nonprofit organizations, and Government. Read *Spinoff* 2012 to find out more about the most recent inventors, innovators, and technologies that have won awards for unique contributions to aircraft design, thermal insulation, solar energy, robotics software, and more.





## SPINOFF BENEFITS: BY THE NUMBERS

By investing in aerospace technology, NASA invests in our Nation. By 2012, NASA partners had generated \$5 billion in revenue and saved \$6.2 billion in costs, thanks in part to their collaborations with the Agency. In total, over the last 12 years, these same partners have created 14,000 jobs while spinoff technologies have saved 444,000 lives.\* See details on the quantifiable benefits of NASA spinoff technologies inside *Spinoff* 2012.



## BENEFICIAL PARTNERS

The outcomes of NASA's innovative partnerships are as diverse as they are beneficial. Through collaborations with the best of business, industry, Government, and academia, NASA not only advances its own missions but arrives at solutions to significant problems for the Nation and the world. Read more about NASA's beneficial partnerships in *Spinoff* 2012.



# ... AND MUCH MORE.

To learn about all of this and more, and to get your own free copy of *Spinoff* 2012, scan this code or visit <http://spinoff.nasa.gov>.



\*Data based on a NASA survey of partner companies featured in *Spinoff* since 2000, with approximately 30 percent of surveyed companies responding to date.





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NP-2013-02-929-HQ