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Researchers Recognized for Environmental Cleanup Technology

KENNEDY SPACE CENTER WINS INVENTION OF THE YEAR

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imagination

Imagination will often carry us to worlds that never were. But without it, we go nowhere.

—Carl Sagan

COVER STORY

Invention of the Year

Researchers are recognized for environmental cleanup technology.

feature articles

departments

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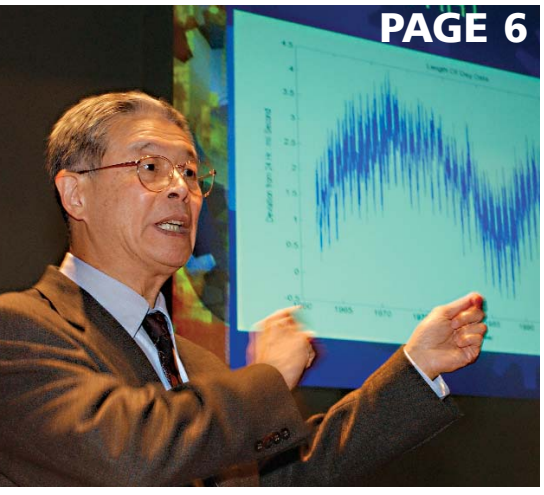

NEWS BRIEF: DR. NORDEN HUANG, A FINALIST FOR SERVICE TO AMERICA MEDALS, EXPLAINS HILBERT-HUANG TRANSFORM (HHT) TECHNOLOGY, A REVOLUTIONARY, ADAPTIVE SET OF SIGNAL-ANALYSIS ALGORITHMS.

FACILITY FOCUS: AN ENGINE IS BEING SET UP FOR TESTING IN THE PROPULSION SYSTEMS LABORATORY AT GLENN RESEARCH CENTER.

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UPFRONT with...

Carol A. Dunn

Project Specialist, Kennedy Space Center

EXCELLENCE

The United States wouldn't have a space program without a commitment to excellence—that indefinable "something" that has propelled men and women for centuries into the realms of achieving the impossible. NASA is more than a federal agency, it is an imaginative idea exemplified by its commitment to achieving the highest standards in engineering, science, management and leadership. The agency attracts people because it offers a vision that challenges the intellect and offers a rigor of purpose. This rigor of purpose can only be achieved by a hallmark of excellence. This hallmark of excellence often manifests itself in imaginative and creative solutions to problems.

Albert Einstein once said, "Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world." I see this hallmark of excellence every day in my position as a project specialist. Men and women solving today's problems with a commitment to the future—imagination blended with science. These people truly demonstrate and communicate an unquenchable spirit of ingenuity and innovation; and in turn, inspire me to process their paperwork with a regard for the importance and integrity of their work.

One such technology that demonstrates the combination of both scientific excellence and imagination is Kennedy Space Center's Zero-Valent Metal Emulsion for the Reductive Dehalogenation of DNAPLs (EZVI). During the early history of the space program, the ground around Launch Complex 34 (LC-34) at Kennedy Space Center was polluted with chlorinated solvents used to clean Apollo rocket parts. Dense non-aqueous phase liquids (DNAPLs) were left untreated in the ground.

EZVI is one of the few available methods that can treat the source of these unwanted substances known as dense nonaqueous phase liquids, or DNAPLs. Benefits of this technology include requiring less treatment time, reducing treatment costs and producing less toxic and more easily degradable by-products. The product is also safe for the environment. The groundwater treatment technology developed at Kennedy Space Center combines a food-grade surfactant, biodegradable vegetable oil, water and ZVI particles (either nano- or micro-scale iron), which form emulsion particles that contain the ZVI in water surrounded by an oil-liquid membrane. Encapsulating the ZVI in a hydrophobic membrane protects the nano-scale iron from other groundwater constituents that would otherwise exhaust much of the reducing capacity of the nano-scale iron. EZVI was developed by a team of researchers from NASA and the University of Central Florida.

Whether it is an environmental process for cleaning contaminated ground water at the launch pads or a process that turns nitrogen oxide waste to fertilizer, the fallouts from the space program have contributed to the wealth of human knowledge. Science propels these quests of the imagination and continues to propel the men and women of NASA as we pioneer into the future. Carl Sagan once said, "We make our world significant by the courage of our questions, and by the depth of our answers." The men and women I associate with each day truly exemplify the NASA value of "excellence" in their work as scientists and engineers.

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Goddard's Norden Huang a Finalist for Service to America Medals

When you win NASA's Invention of the Year, chances are you're working on some pretty complex issues that anyone without a Ph.D. might have difficulty understanding. That is certainly the case with Dr. Norden Huang, chief scientist for oceanography at Goddard Space Flight Center. But while the details of Huang's work may be difficult to comprehend, anyone who sees the practical applications of his work can grasp its importance.

That is why the Partnership for Public Service has selected Huang as a finalist for its Service to America Medals. The awards pay tribute to America's dedicated federal workforce, highlighting those who have made significant contributions to our country. Honorees are chosen based on their commitment and innovation as well as the impact of their work on addressing the needs of the nation.

Huang's pioneering research led to the development of the Hilbert-Huang Transform (HHT) technology, a revolutionary, adaptive set of signal-analysis algorithms. Unlike precursor technologies, HHT provides an effective method for analyzing nonlinear and nonstationary signals (such as those occurring in natural phenomena) while improving the accuracy of linear and stationary signal analysis. In winning the 2003 NASA Government Invention of the Year award, HHT was cited as "one of the most important discoveries in the field of applied mathematics in NASA history."

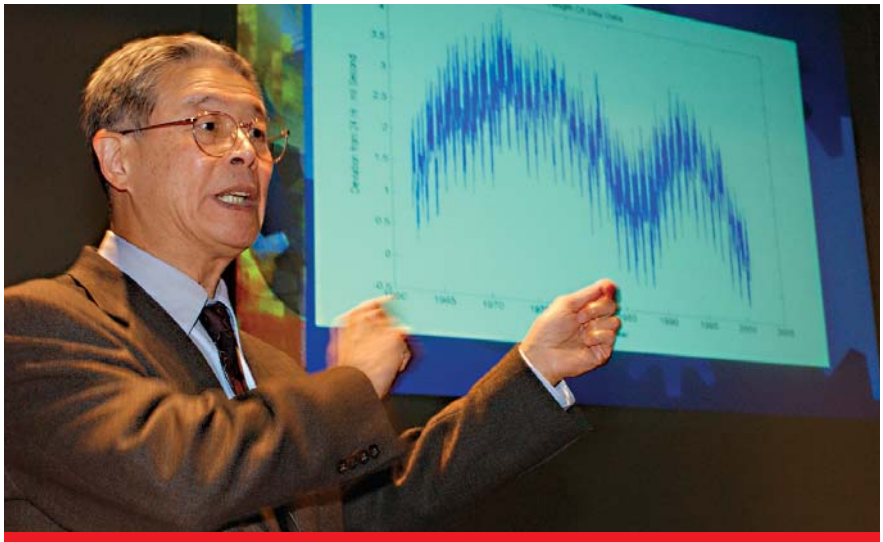

PHOTO CREDIT: GSFC

Dr. Norden Huang, a finalist for Service to America Medals, explains Hilbert-Huang Transform (HHT) technology, a revolutionary, adaptive set of signal-analysis algorithms.

The importance of Huang's research on HHT is well demonstrated by the benefits and versatility the technology offers to a wide variety of fields.

Within NASA, Huang's work with HHT is benefiting analysis of wing-flutter tests and the next generation of aircraft design. His research has also contributed to shuttle mission safety by using HHT to test the tiles that insulate the shuttle in space for the Shuttle Return to Flight Project. HHT also helps NASA look for planets and black holes.

HHT also might become a useful weapon in the war on terror. Federal investigative organizations are working to incorporate HHT into systems to analyze speech patterns and identify individuals in recordings in forensic examinations.

And the applications go on. The Navy is using HHT in its research to improve submarine design and to more easily identify and locate different types of submarines. The Federal Highway Administration is using HHT in a variety of research areas, including monitoring the vibration of bridges to determine how safe they are and highway design and engineering studies. According to FHWA, HHT

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has been a critical element for accurate data analysis.

For the medical field, HHT is helping researchers understand biomedical and physiological phenomena, which enables them to improve diagnoses and treatments, including drug design, sensors, devices, imaging and tissue engineering. Specifically, Huang is involved in research at Johns Hopkins University's Bloomberg School of Public Health, using HHT to better understand how a wide variety of diseases, including avian flu and Dengue Fever, are propagated. HHT also is being used at Harvard Medical School's Beth Israel Deaconess Medical Center to help sharpen the diagnosis of sleep apnea and to detect patients with impaired blood flow regulation in the brain, a condition that may increase the risk for stroke.

Looking at this list of ways that Huang's work has the potential to improve the quality of life for all Americans and to meet critical national needs, there is one other thing that is easy for anyone to understand, Dr. Norden Huang is an extraordinary public servant.

"It is an honor to be selected as a finalist for this award," says Huang. "It's been an pleasure and a privilege to work with so many great people—both inside and outside NASA—over the years. I am lucky to have found the HHT method so simple and yet versatile, and I am really pleased to have that work recognized."

Huang was announced as a finalist in June; the final Service to America Medals will be awarded in September. ■

For more information, contact Goddard's Office of Technology Transfer at techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Space Foundation Announces 2006 Space Technology Hall of Fame Inductees

The Space Foundation has announced that the iRobot PackBot Tactical Mobile Robot and Novariant AutoFarm RTK AutoSteer are the 2006 inductees into the Space Technology Hall of Fame.

The individuals and organizations who adapted these technologies were recognized in April at a private induction ceremony and at the Space Technology Hall of Fame dinner.

Since 1988, the Space Technology Hall of Fame has honored 52 technologies and the innovators who transformed them into commercial products that improve life here on Earth. The Space Foundation, in cooperation with NASA, established the Space Technology Hall of Fame to increase public awareness of the benefits that result from space exploration programs and to encourage further innovation.

The iRobot PackBot is a tactical mobile robot used in urban terrain operations. Technology originally developed for Martian rovers was incorporated into the PackBot, including lightweight, high-torque actuators used for control, a strong but lightweight frame structure and a riveted sheet-metal chassis. Currently, more than 300 PackBots are in use in Afghanistan and Iraq to clear caves and bunkers, search buildings, safely disrupt Improvised Explosive Devices and landmines, and even relay video, audio and sensor readings. The Defense Advanced Research Projects Agency (DARPA), iRobot Corporation and NASA's Jet Propulsion Laboratory were recognized as the innovating organizations of the PackBot technology.

AutoFarm's AutoSteer uses the improved Real Time Kinematic (RTK) Global Satellite Positioning (GPS) system to steer farm tractors automatically and ensure straight, repeatable rows. The technology originally was developed to track the orientation of NASA's Gravity Probe B project, which is testing two

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PHOTO CREDIT: SPACE FOUNDATION

PRESIDENT & CHIEF EXECUTIVE OFFICER OF THE SPACE FOUNDATION ELLIOT G. PULHAM(FAR LEFT) WITH THE 2006 SPACE TECHNOLOGY HALL OF FAME INDUCTEES (LEFT TO RIGHT) HERB SATTERLEE AND GAYLORD GREEN REPRESENTING THE NOVARIANT AUTOFARM RTK AUTOSTEER; HELEN GREINER, RICHARD MCCORMICK AND LT. GEN EUGENE TATTINI REPRESENTING THE IROBOT PACKBOT TACTICAL MOBILE ROBOT; AND ROBERT S. WALKER, THE SPACE FOUNDATION'S CHAIRMAN OF THE BOARD.

unverified predictions of Albert Einstein's general theory of relativity. AutoSteer can dramatically increase crop yields by maximizing agricultural outputs. The Gravity Probe B Lab and Novariant Corporation were recognized as the innovating organizations of the AutoSteer technology.

Founded in 1983 and headquartered in Colorado Springs, Colo., the Space Foundation is a national nonprofit organization that vigorously advances civil, commercial and national security space endeavors and educational excellence. The Space Foundation has offices in Washington, D.C., and Cape Canaveral, Fla. ■

For more information, visit www.SpaceFoundation.org.

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Ohio Companies Receive Partnership Awards from NASA Glenn and Alliance Partners

The Glenn Alliance for Technology Exchange (GATE) presented four Ohio-based companies with the GATE Partnership Award.

GATE, a collaboration of NASA's Glenn Research Center, the Ohio Aerospace Institute and Battelle's Great Lakes Industrial Technology Center, all of Cleveland, established the Partnership Award Program to aid small Ohio companies interested in enhancing their products and processes with NASA technologies.

Twenty-six proposals were submitted from all over Ohio and four were selected in this second round of GATE Partnership Awards. The award consists of $50,000 in cash plus $50,000 in NASA assistance in developing the new product or process.

"NASA Glenn is proud to transfer its technology and expertise to the products and processes of small companies in Ohio," says Glenn Director, Dr. Julian Earls. "GATE has provided us with a vehicle to reach out and impact these small firms, and, by so doing, impact the economy of the state of Ohio."

The winners of the GATE Partnership Award Program are as follows:

ITEN Industries, Ashtabula, Ohio, will work with researchers from the Polymers Branch at NASA Glenn to create a manufacturing process for a strengthened aerogel, an open-structured silica foam in which 99.8 percent of the volume is empty space. Although it has hundreds of possible uses as a heat, sound and shock insulator, aerogel is extremely fragile. NASA researchers have created a process to strengthen aerogel but it only has been produced

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in a tightly controlled laboratory environment. A viable manufacturing process should lead to a material that is affordable, strong and easy to create.

Theken Disk, LLC, Akron, Ohio, will partner with NASA Glenn's Antenna, Microwave and Optical Systems Branch and the Electron and Optical Devices Branch. Together, they will pursue development of an artificial spinal disc with the capability of communicating data to an external receiver for post-operative monitoring. Theken's spinal implant, the eDISC, employs a unique design that mimics the movement and load response of a natural spinal disc. The team's addition of a MicroElectroMechanical System sensor and a radio-frequency antenna to the eDISC should allow surgeons to monitor patients for up to one year after surgery.

H Cubed Inc., Olmsted Falls, Ohio, will leverage its existing work with NASA Glenn's Life Prediction Branch and the BioMEMS group at the Cleveland Clinic to further the development of high resolution ultrasonic transducers for use in intravascular ultrasound (IVUS) devices. IVUS imaging is used to detect coronary artery blockages. The transducers developed under this project should vastly improve resolution and image quality of IVUS devices, making them more useful tools for cardiologists.

Innovative Engineering & Consulting, Middleburg Heights, Ohio, will work with the Diagnostics and Data Systems Branch at Glenn to develop an innovative Infrared (IR) imaging system. Current commercial IR devices, used for such essential tasks as locating survivors in a burning building, can have limited effectiveness when intense heat sources are present. The proposed Enhanced Dynamic Range Thermal Imager would allow a firefighter to differentiate an intense heat source, such as a fire, from a person. This product also has applications in defense and security fields.

"We are creating research and technology partnerships of direct benefit to Ohio-based companies and to NASA Glenn. Tapping into cutting-edge R&D at Glenn to help businesses in Ohio is critical to technology-based economic development," says William Seelbach, president and CEO of the Ohio Aerospace Institute and GATE Project Manager.

"These awards can make a critical difference to small technology-based companies by providing an infusion of federally-funded technology expertise. This alliance, in partnership with NorTech and our Ohio legislators, is growing technology companies in our own backyard," says Priscilla Diem, executive director, Great Lakes Industrial Technology Center.

The Glenn Alliance for Technology Exchange was established in October 2004. GATE offers several mechanisms designed to foster technology transfer initiatives between NASA Glenn and Ohio companies. ■

For more information, contact Laurel Stauber, Glenn Research Center, (216) 433-2820, Laurel.J.Stauber@nasa.gov.

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NASA Ames Research Center Technology Featured in New Anti-Icing Windshield Spray

A new product using a NASA-based technology might make winter just a little easier to endure for those living in parts of the United States where snow and ice are common.

Ice Free is a simple and safe spray treatment that prevents ice, snow and other winter cold effects from bonding to a glass surface. Applied to a vehicle's windshield and windows before inclement weather hits, Ice Free provides protection in temperatures as low as minus 20 degrees Fahrenheit. WorldSource Inc., a developer and distributor of products for the consumer marketplace, produces Ice Free.

"As we continue to explore the universe, we are proud that NASA's

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pioneering efforts keep fueling American creativity, innovation and technology development," says David Morse, acting chief of the Technology Partnerships Division at NASA Ames Research Center in Moffett Field, Calif. "This new product is yet another example of the additional dividends Americans reap from their investment in space exploration."

The technology, based on an anti-icing fluid developed by a three-engineer team at Ames, led to the creation of Ice Free. The team designed a non-toxic fluid to prevent ice from building up on airplanes. At the time, the anti-icing fluid was hailed for making flying safer without introducing dangerous chemicals into the environment. In fact, the fluid was biodegradable and so environmentally safe that it was referred to as "food grade," because its ingredients were approved for use in food by the Food and Drug Administration.

When co-inventors Leonard Haslim, John Zuk and Robert Lockyer of Ames announced their invention in 1997, the fluid was said to be able to prevent ice buildup on airplane wings and on other surfaces such as automobile windshields, a feature retained in the new product.

"A commuter is much more likely to start his drive without having to spend the time scraping ice and snow off the car windows. We feel it is a great product, and we thank NASA for the opportunity to market Ice Free," says Brian Jue, WorldSource chief executive officer.

"I often heard how advancements due to NASA research and development help mankind enormously, and, if you live in an icy part of the U.S., this is further proof of the accuracy of that statement," says Bob Harrick, president of WorldSource. "NASA technology played a key role in the development of this very useful product."

Ice Free is marketed on the Internet and TV. ■

For more information, contact Phil Herlth, Ames Research Center, (650) 604-0625, pherlth@mail.arc.nasa.gov.

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NASA Receives FLC Awards

Several NASA field centers recently received 2006 FLC Awards for outstanding achievements in the field of technology transfer.

Marshall Space Flight Center was the recipient of Project of the Year honors for its High-Strength, Wear-Resistant Aluminum Alloy, while Kennedy Space Center took home an Excellence in Technology Transfer award for its Zero-Valent Metal Emulsion for Reductive Dehalogenation of DNAPLs.

Honorable mention award recipients include:

- Glenn Research Center for Multi-Parameter, Microsensor-Based Low False Alarm Fire Detection System (MMFDS) for Aircraft
- Goddard Space Flight Center for GPS-Enhanced Onboard Navigation System (GEONS/GEODE); Micro Pulse Lidar (MPL) and the MPL Network (MPLNET); and Recursive Hierarchical Segmentation (RHSEG) Pre-processing Software: For Analyzing Imagery Data
- Marshall Space Flight Center for The TRACeR III-V (NASA-enhanced X-Ray Fluorescence (XRF) Scanner)

The Federal Laboratory Consortium for Technology Transfer (FLC) is the nationwide network of federal laboratories that provides the forum to develop strategies and opportunities for linking the laboratory mission technologies and expertise with the marketplace. Each year, groups and individuals are honored by the FLC for their work in projects that advance the mission of technology transfer. ■

For more information, visit http://www.federallabs.org

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Looking Back

A FOLLOW-UP ON A NASA SUCCESS

Automotive Insulation for Stock Car Competition

Beating the heat in a stock car competition is another kind of space race that demands thermal protection materials.

Under a Space Act agreement between Boeing North America (formerly known as Rockwell Space Systems) and BSR Products Inc., of Mooresville, N.C., Space Shuttle Thermal Protection System (TPS) materials that orbit the globe have circled the race track.

BSR created special TPS blanket insulation kits for use on autos that take part in National Association for Stock Car Auto Racing (NASCAR) events, and other race cars through its nationwide catalog distribution system.

NASA's fleet of orbiters are protected by TPS materials inside and out, from the sometimes space-exposed cargo bay to the space plane's outer surface. Developed by Rockwell, classes of TPS tiles and thermal blankets safeguard Space Shuttle orbiters as they slam back into Earth's atmosphere. Reentry heat loads can be as high as 3,000 degrees Fahrenheit during the plunge.

The idea of using Space Shuttle TPS to insulate heat-generating areas of stock cars came by way of a tour taken by NASCAR champion Bobby Allison at Kennedy Space Center (KSC). Then KSC Director, Jay Honeycutt, a racing fan himself, recommended to Allison that TPS insulation could shield drivers from excessive heat exposure.

Speeding race car drivers are in the hot seat in more ways than one. It has been estimated that temperatures inside a race car's cockpit can soar to a sweltering 140 to 160 degrees. It is common for NASCAR drivers to endure blisters and burns due to the excessive heat flooding into the cockpit. That extreme heat comes through the engine firewall, transmission tunnel and floor. High temperatures, in fact, have led to many totally exhausted drivers being hauled out of their cars after a grueling meet.

PHOTO CREDIT: KSC

THE LINE OF INSULATION INCLUDES FLOOR PANELS, OIL TANK BLANKETS, FILTERS, TRANSMISSION TUNNEL BLANKETS AND EXHAUST CROSSOVER SHIELDS. THE INSULATION LOWERS RACE CAR TEMPERATURES AND KEEPS DRIVERS COOLER.

Intrigued by the use of TPS, Allison contacted colleague and rival, Roger Penske, who was able on short notice to loan a stock car to KSC for one day of TPS retrofitting.

Penske team members, Rockwell and NASA personnel worked together to pattern TPS material to fit Penske Racing Inc.'s No. 2 Ford Thunderbird stock car. The TPS insulation extras added less than four pounds to the car. Later tests clearly showed significant temperature drops in locations where the TPS material was used. In the driver's cockpit, temperatures were lowered by some 50 degrees.

A big thumbs up was given to the TPS additions by NASCAR driver Rusty Wallace. He raced several times with the material and participated in an instrumented test at Daytona International Speedway in April 1996.

BSR identified numbers of areas in stock cars that would benefit from selective touches or a mix of Space Shuttle TPS materials, such as: under the driver's seat and ancillary components; between floorpan and exhaust system on the driver's side; for insulating the oil tank; to shield the ignition system; and for installation under the driver's feet and along the side of the transmission tunnel and behind the pedals. ■

NASA ANNOUNCES 2005

ENVIRONMENTAL CLEANUP TECHNOLOGY EARNS TOP HONORS

By Carol A. Dunn

A groundwater treatment technology developed at NASA Kennedy Space Center has won NASA's Government Invention of the Year and Commercial Invention of the Year awards for 2005. This marks the second time in three years that KSC inventors have won both awards.

The Emulsified Zero-Valent Iron (EZVI) technology was developed by a team of researchers from NASA and the University of Central Florida. NASA inventors include Dr. Jacqueline Quinn, an environmental engineer in the Applied Sciences Division of the Kennedy Applied Technology Directorate, and Kathleen Brooks, an analytical chemist in the center's Materials Science Laboratory of the Center Operations Directorate. Drs. Christian Clausen, Cherie Geiger and Debra Reinhart are co-inventors from the university's Departments of Chemistry and Civil Environmental Engineering.

During the early history of the space program, the ground around Launch Complex 34 (LC-34) at Kennedy Space Center was polluted with chlorinated solvents used to clean Apollo rocket parts. Dense non-aqueous phase liquids (DNAPLs) were left

PHOTO CREDIT: KSC

A GROUT PUMP IS BEING USED TO DIRECTLY INJECT EZVI INTO COLUMNS OF EMULSION. THIS TECHNIQUE IS TYPICALLY USED FOR SMALLER JOBS SUCH AS DRY CLEANING FACILITIES.

untreated in the ground and contaminated the fresh water sources in the area. A DNAPL is a liquid that is denser than water and does not dissolve or mix easily in water. DNAPLs are a common cause of environmental contamination at thousands of DOE, DOD, NASA and private industry facilities. The EPA has reported that DNAPLs are present at 60-70 percent of all sites on the Superfund National Priorities List. Current approaches for remediation of DNAPL source areas are either inefficient, slow or costly.

In response to this environmental contamination, KSC developed Emulsified Zero-Valent Iron (EZVI) for the in situ treatment of DNAPLs. EZVI shows significant promise as a cost-effective remediation technology capable of expediting DNAPL source zone remediation and groundwater cleanup. The EZVI is composed of a food-grade surfactant, biodegradable vegetable oil, water and ZVI particles (either nano- or micro-scale iron), which form emulsion particles that contain the ZVI in water surrounded by an oil-liquid membrane. Since the exterior oil membrane has hydrophobic properties similar to that of DNAPL, the emulsion is miscible with the DNAPL. Encapsulating the ZVI in a hydrophobic membrane protects the nano-scale iron from other groundwater constituents that would otherwise exhaust much of the reducing capacity of the nano-scale iron.

DNAPL, especially of the magnitude present at LC-34, is likely to persist in the aquifer for several decades or even centuries. The resulting groundwater contamination and plume also will persist for several decades. The conventional approach to this type of contamination is to use pump-and-treat systems that extract and treat the groundwater above ground. This conventional technology is basically a plume control technology and would have to be implemented as long as groundwater contamination exists. The EZVI application is an innovative in situ technology that will greatly exceed the capabilities of conventional pump-and-treat systems both in time to achieve cleanup and cost avoidance. By encapsulating the reactants in a hydrophobic membrane of oil, the emulsion behaves like a DNAPL. When placed in the subsurface, it attracts the contaminant into the hydrophobic membrane, and the reactant then attacks the contaminant and successfully removes the DNAPLs. Other technologies inject reactants in water slurries, and since the DNAPLs are hydrophobic, the contaminants reject the "treatment remedy" and the problem remains.

EZVI overcomes the previous understanding that the incorporation of zero-valent metal particles, such as iron particles, into a liquid mem-

PHOTO CREDIT: KSC

EZVI team members (left to right) include Dr. Christian Clausen, Dr. Jacqueline Quinn, Kathleen Brooks, Dr. Debra Reinhart and Dr. Cherie Geiger.

brane micelle would lead to passivation of the particle surface with regard to its ability to dehalogenate compounds. Kinetic studies have shown that the dehalogenation rates of zero-valent metal emulsions are very high and, in fact, are much higher than free zero-valent metal particles with regard to the dehalogenation pools of pure DNAPL. A beneficial feature of the zero-valent metal emulsion is that no halogen-containing atoms exit from the micelle during remediation.

This technology is one of the few methods available that can treat the DNAPL source. EZVI overcomes the limitations of current DNAPL treatment technologies by providing a method that is quick, effective and cost-competitive. Other benefits of the innovation include direct treatment of the contaminant source; contaminants are not mobilized; produces less toxic and more easily degradable by-products; and it is environmentally safe. The relatively low injection costs and long-term residual remediation activity indicate that EZVI can result in significant operational lifetime cost savings.

KSC has signed five nonexclusive licenses with companies wanting to market and further develop EZVI. One company in particular, GeoSyntec, intends to market this

PHOTO CREDIT: KSC

A RESEARCHER SHOWS THE EMULSION IN THE SOIL.

innovation to clients across North America, Europe and Australia. Additionally, GeoSyntec also has been awarded funding from the DOD Environmental Security Technology Certification Program (ESTCP) to enhance the application of this technology through further laboratory and field demonstrations. GeoSyntec completed demonstration testing of the EZVI technology at the Cape Canaveral Air Station Launch Complex 34 (LC-34) under the NASA STTR program in 2002 and 2003. As of April 2006, EZVI has been applied at both government and private industry cleanup sites by the other four licensees in Arkansas, Tennessee, Florida, North Carolina and Illinois.

Recipients/technology end-users of the EZVI cleanup technology include government installations, local and state governments and private industry. Cleanup programs across five federal agencies aimed at DNAPL removal are estimated to exceed $200 billion over the next 75 years (Soil and Groundwater, August/September 1997). EZVI will help to address these problems within the federal government and across private industry. New and continued relationships were established during the field application of the technology with the EPA Superfund Innovative Technology Evaluation Office and with numerous environmental consultants interested in applying the technology to their customers' cleanup sites across the United States and other countries. Additionally, a close working relationship was developed with the U.S. Air Force, who chose in 2005 to deploy the largest EZVI injection to date (>62,000 gallons) at Patrick Air Force Base, Florida. Additionally, working relationships with the U.S. Marine Corp and the U.S. Navy are continually developing, as the next EZVI demonstration under the DOD certification program began in May 2006 at Parris Island Marine Training Base, South Carolina. The EPA is again participating in this deployment, with interest in documenting the biological benefit (polishing effects) of the emulsion.

The technology transfer recipients for EZVI are far reaching, from United States government installations like the KSC and Cape Canaveral Air Force Station to local dry cleaner programs such as the one currently funded by the state of Florida. Private industry is deemed a potentially significant user of the technology, as the government is not the sole owner of chlorinated-solvent groundwater pollution. Within the first year of licensing, EZVI has been deployed at four industrial locations with great success and at three locations within the DOD. For one of the DOD deployments, the estimated cost for the EZVI alone is nearly $1 million.

This technology has won the SE Federal Labs Consortium 2005 Excellence in Technology Transfer award, the national Federal Laboratory Consortium Excellence in Technology Transfer Award for 2006, the NASA 2005 Invention of the Year Award and the 2005 NASA Commercial Invention of the Year Award. ■

Opportunity for Partnership

Global Alert Resolution Network (GARNET)

NASA Goddard Space Flight Center invites companies to license its Global Alert Resolution Network (GARNET), an enterprise software application capable of delivering emergency and time-sensitive alerts to affected individuals via a variety of communication channels. Alerts can be delivered within an organization to employees, or outside an organization to large pools of subscribers, such as organization and community members.

Ideal for commercial, academic and government communication plans, GARNET enables alert dissemination to multiple communication devices, including desktop computers (PCs and MACs), UNIX-based environments, cell phones, pagers, e-mail applications and personal digital assistants (PDAs). The software also offers plug-ins that enable organizations to integrate notification systems already in use, such as sirens or alarms, public address (PA) systems and closed circuit television (CCTV). Supporting both internal and external alerts, GARNET employs "push" technology to distribute emergency-related messages as well as "pull" technology to support commercial or non-emergency notifications to administrator-managed subscribers (e.g., customers or trading partners).

Benefits

Fast: Alerts are issued in near real-time to many users over multiple communication mediums, reaching a larger percentage of users faster than with individual systems.

Flexible: GARNET can support a wide variety of communication channels, including e-mail, cell phones, personal computers (PCs) and PDAs, and provides the flexibility to include other communication devices as they are developed and adopted.

Scalable: GARNET can support a growing base of users, both internal to an organization (behind a firewall) and external users or customers. The software can also operate from a low-end, simple-server setup to a clustered server system providing seamless failover and load balancing.

Cross-platform compatible: Written in Java, the software supports multiple platforms including Microsoft Windows, Mac OS, Linux and UNIX, enabling administrators to seamlessly incorporate the software with other IT systems.

Secure: Communication is secured using Secure Sockets Layer (SSL), server push/client pull technologies and firewalls. Configuration also enables only authorized administrators to enter alerts over secured communication channels.

Unobtrusive: A high level of granularity in notification controls helps ensure that only affected personnel, users or customers are interrupted, helping to avoid confusion and maintain productivity among unaffected employees.

Simple: Implementation is straightforward through an online administration console. A simple-to-use interface enables administrators to tailor who is notified, what medium is used and how alerts are displayed.

Proven: The software has undergone extensive testing (both inside and outside a firewall) at two NASA facilities.

Affordable: The software can be hosted on an economical, single-server setup or on a redundant server system for improved reliability, meeting the needs of various customers and budgets.

ADA Compliant: Existing alert systems (e.g., fire alarms, PA systems, CCTV) can be integrated with the software to provide further communication options for hearing- or sight-impaired users. Fully compliant with Section 508 of the U.S. Rehabilitation Act, the software provides full access to all individuals, regardless of handicap.

Applications

GARNET can be used by any organization needing a reliable, near-real-time delivery method for emergency alerts as well as other time-sensi-

tive messages and announcements. Federal, state and local governments, as well as education and industry, can benefit from GARNET's wide-range of alerting applications:

- Emergency alerts
- Fire or building evacuation notifications
- Computer virus attack alerts
- Severe weather warnings
- National security alerts
- Supply-chain alerts
- Trading-partner notifications
- Enterprise Resource Planning (ERP) alerts such as out-of-stock notifications
- Stock trading alerts
- Facilities and IT alerts
- Network monitoring alerts
- Facility closing
- Road closing or construction
- News broadcasts
- Weather alerts

Disseminating alerts

The heart of the simple-to-use GARNET system is a secure, Web browser–based interface. Authorized administrators enter alerts into the system. The administrator can select a severity level, message delivery method(s) and the group of affected users to whom the alert will be disseminated. The alert is then distributed to only those users, along with a link to further information such as suggested actions and related instructions. Alerts interrupt end-users' work on desktop PCs, cell phones, PDAs and other communication devices, helping to ensure that the message is acknowledged.

Using push and pull technology to increase effectiveness

Desktop PCs have two methods of polling a server for new messages or alerts:

The PC can use software to poll the server at predetermined intervals, known as pull technology. The server can push messages to subscribed clients whenever they are generated. Because e-mail alerts using only pull technology have an inherent delay, they may result in potential hazards in true emergency situations. To increase the timeliness of alert delivery, the GARNET system employs both push and pull technologies. The server is configured to push alert messages to systems that are not behind a firewall. Systems that are behind a firewall poll the server at intervals to receive new alerts. These determinations are made during client software startup and login.

Securing alerts through a reliable system

GARNET provides secure alert-delivery channels using SSL, server push/client pull technologies and firewalls. Administrators are authorized before alerts can be sent through the GARNET system. The system provides separate zones for application servers and for replicated Web servers. Each zone is secured by a firewall. To send alerts, the Internet may refer to a center-wide network or to the Internet itself. Alert access can be limited to the network center to maximize security.

System requirements, configuration and maintenance

Typical installation on a server usually requires the following software*:

- Microsoft Advanced Server (operating system**)
- Apache Tomcat (application server)
- Microsoft IIS (Web server)
- Microsoft SQL Server (database)

*Other software packages may be used, such as Linux, Apache Web Server, and MySQL.

**GARNET supports Windows NT, 2000 and XP desktop clients as well as Mac OS, UNIX and Linux.

Minimum software configuration requires only a central server with a database; however hosting the software on redundant servers with failover and load-balancing capabilities helps improve system reliability.

Maintenance of the software is minimal; however, the system must be retested after any major operating system release and installation or when new versions of Java replace the current version.

Why GARNET is better

Historic and existing alert systems, such as fire alarms, PA systems and sirens, cannot provide the breadth and depth of information distributed by the GARNET system. Specifically, sound-based systems do not provide descriptive information about the alert and may not be adequate for communicating messages to the hearing impaired. Televisions can provide the detail but may not be turned on or

tuned to the right channel to receive alerts. Using only PC or e-mail-based alerts does not account for users who are not at their desks or other e-mail systems. In addition, most existing alert systems cannot avoid interrupting people who may be unaffected by the information being distributed.

Unlike existing systems (or just one means of alert), the GARNET system disseminates timely messages through a wide range of devices, helping to reach a higher percentage of people in a shorter period of time. Unlike many other messaging systems, GARNET is pervasive, interrupting all applications on the user's computer to deliver emergency notifications. In addition, GARNET contacts precisely selected people, helping to ensure that only affected personnel are interrupted. ■

For more information, contact NASA Goddard's Office of Technology Transfer, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Inherently Conductive Polymers

NASA Kennedy Space Center seeks to license inherently conductive compositions (ICP) of matter and methods for the preparation of conductive compositions of matter with increased conductivity (U.S. Patent Nos.: 6,972,098; 6,676,617; 6,299,800; 6,059,999; and 5,968,417). Electrically conducting polymers are of great interest because of potential applications where they may replace metals and semimetals that require comparatively more energy in processing. ICPs have electrical conductivity properties similar to inorganic semiconductors and as a result, are able to discharge static before charges reach unsafe levels. A need existed for novel electrically conducting polymers with increased solubility, increased processability and that can be prepared from inexpensive materials.

NASA developed ICPs that are comprised of sulfonated lignin or lignosulfonate. Lignin is a principal constituent of the wood structure of higher plants, and ranks second to cellulose as the most abundant organic material. The sulfite process of the paper and wood-pulp industries yields a spent liquor that comprises sulfonated lignins (i.e. lignosulfonates) and are inexpensive polyaryl-sulfonic acids that are highly soluble in water.

Additionally, the NASA ICPs can be utilized as a Corrosion-Resistant Polyaniline Primer. The Primer provides corrosion resistance superior to current coatings on the market, and it can reduce the cost of replacing and repairing corroded materials. This primer can be applied to metals exposed to corrosive environments. It adheres to a wide range of bases and topcoats and protects against corrosion even when bare metal is exposed.

Options for Commercialization

This technology opportunity is part of the NASA Technology Transfer Program. The program seeks to stimulate development of commercial applications from NASA-developed technology. NASA seeks qualified companies to license and commercialize this technology.

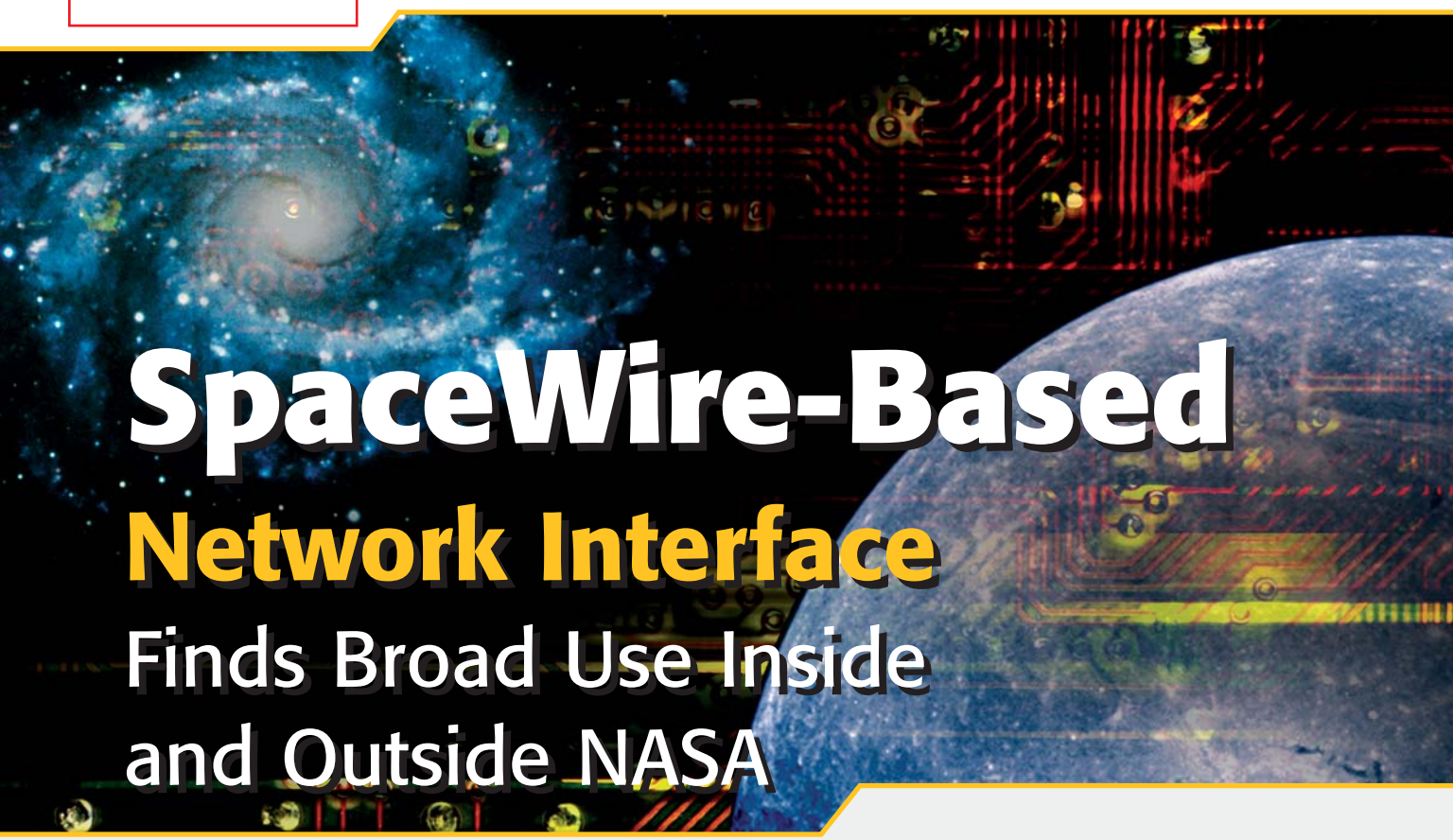
Potential Commercial Uses

This technology is the focus of material science research due to its novel optical and electrical properties that can find applications in:

- Anti-static coatings, fabrics, and packaging
- EMI/RFI shielding
- Electro chromic "smart" windows
- Rechargeable Batteries
- OLEDs (organic light emitting displays)
- RFID
- Corrosion-resistant Coatings ■

For more information, contact NASA Kennedy Space Center's Office of Technology Transfer, (321) 861-7158, technology.transfer@ksc.nasa.gov.

Please mention that you read about it in Technology Innovation.



SpaceWire-Based Network Interface Finds Broad Use Inside and Outside NASA

A network interface based on the new SpaceWire protocol is accelerating NASA's technology development, reducing costs and enabling complex architectures for space-flight electronics. Developed, tested and verified at Goddard Space Flight Center in Greenbelt, Md., the network interface is being incorporated into multiple NASA missions while also making its way into commercial aerospace applications.

Within NASA, the SpaceWire-based network interface is being used in innovative technology development at Glenn Research Center, the Jet Propulsion Laboratory, Langley Research Center and Marshall Space Flight Center as well as at its home center in Maryland.

One project benefiting from Goddard's technology is the Integrated Science Instrument Module (ISIM) for the James Webb Space Telescope (JWST), which is scheduled to launch in 2013. The four-instrument ISIM is the heart of the JWST.

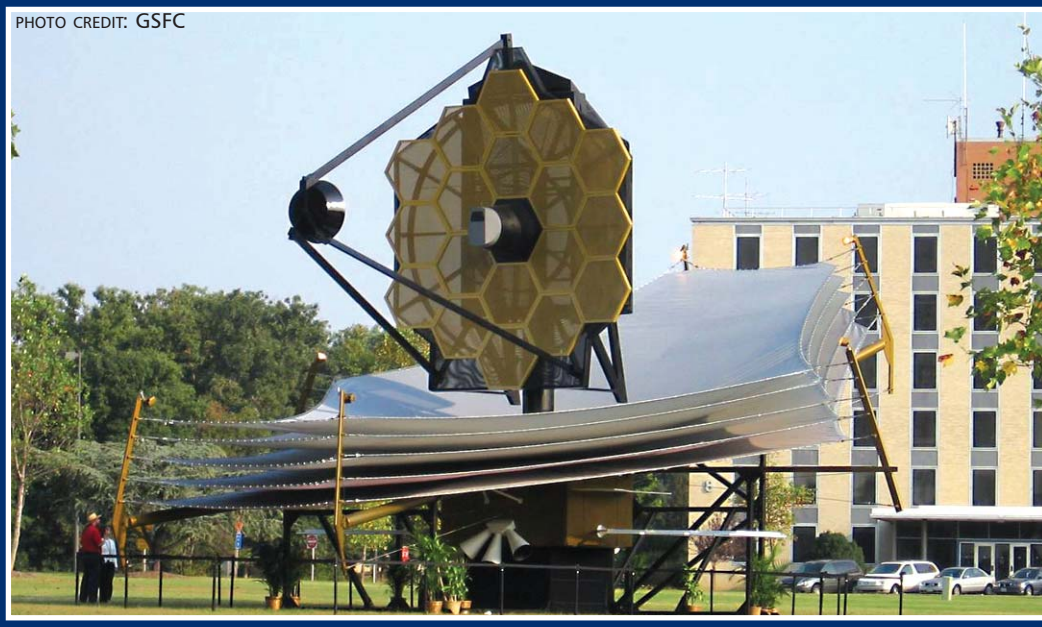
"Infusing Goddard's SpaceWire-based network interface into the JWST mission enables scientific discovery by allowing our four science instruments to operate at very high data collection rates," says ISIM manager Pamela Sullivan.

Using Goddard's technology dramatically accelerated the development of the JWST instrument electronics, explained Sullivan. "We were able to implement the design in a single FPGA chip and deliver it to the instrument teams at the start of their preliminary design phase. [It] saved us more than six months in the development of the instrument electronics."

Other NASA projects using technologies based upon Goddard's network interface include the Lunar Reconnaissance Orbiter and the R-Series of the Geostationary Operational Environmental Satellites, which is also referred to as GOES-R.

Goddard's SpaceWire-based network interface also is being used commercially. In addition to the fact that most major aerospace companies have accessed the technology either for government projects or through a 90-day evaluation license, Goddard's Office of Technology Transfer is putting agreements in place for the technology to be used in commercial

PHOTO CREDIT: GSFC



THE JAMES WEBB SPACE TELESCOPE (JWST) IS ONE PROJECT BENEFITING FROM GSFC'S TECHNOLOGY. THE FOUR-INSTRUMENT ISIM IS THE HEART OF THE JWST. PICTURED IS A FULL-SCALE MODEL OF THE JWST.

applications.

One such agreement, which was signed in 2005, involves the technology's inventor helping a major aerospace company adapt Goddard's network interface to support the company's own space-flight missions. In addition to being reimbursed for this support, NASA will have access to the modifications.

Similar agreements are currently being negotiated with four leading aerospace companies. U.S. companies also can obtain free access to Goddard's technology via a Software Usage Agreement (SUA).

Developed in 1999 under the auspices of the European Space Agency, SpaceWire solved a long-standing problem: the lack of a standard high-speed communications protocol for space-flight electronics. Because of this issue, all electronic payloads (processing units, onboard computers) had to be custom-designed on a project-by-project basis, resulting in long development periods, high costs and elevated risks. "SpaceWire lets you create one design that you can go to every time, for every mission," says Goddard's Glenn Rakow, SpaceWire development lead.

Rakow is NASA's expert on SpaceWire. "His innovative development of SpaceWire capabilities and expertise at NASA Goddard has established us as the internationally recognized expert in the development and delivery of products and features to support Earth and space science missions," says Goddard's Mark Voyton of the JWST team. ■

For more information about accessing Goddard's SpaceWire-based technology, contact Ted Mecum, (301) 286-2198, ted.mecum@nasa.gov.

Please mention that you read about it in Technology Innovation.

NASA, SPACEHAB Advancing Air-Monitoring Technology

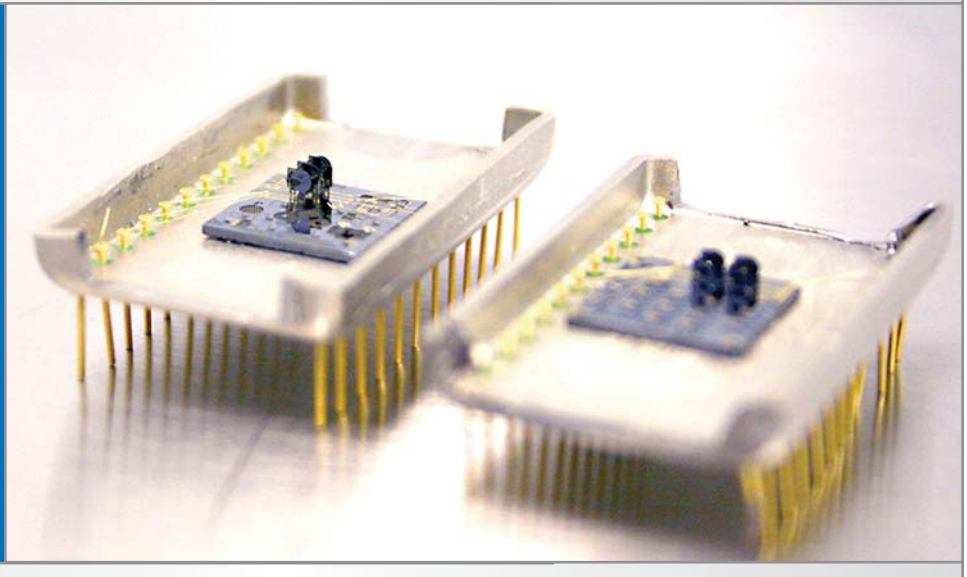


PHOTO CREDIT: JSC

RESEARCHERS AIM TO REDUCE THE AIR MONITORING EQUIPMENT'S SIZE TO THAT OF A DECK OF CARDS WHILE INCREASING ACCURACY AND RESPONSE TIME. LOWER MANUFACTURING COSTS MIGHT REDUCE PURCHASE COSTS OF THE ADVANCED AIR-QUALITY SYSTEMS.

The air in spacecrafts and homes might get cleaner, thanks to NASA's two-year joint-research partnership with SPACEHAB Inc.

NASA will begin testing miniature mass spectrometers that can detect and measure pollutants. The resulting development of a compact, portable system that monitors air contaminants may help clear the air in spacecrafts and homes.

Mass spectrometer technology provides a powerful tool to monitor volatile compounds, such as carbon monoxide and nitrogen, in the air. The device probes the chemical molecules in the air, breaking them into fragments and, by use of magnetic fields, deflects them to identify and measure their concentration levels.

"In space, we worry about air pollution that may adversely affect crew members' health," says John James, chief toxicologist at NASA Johnson Space Center in Houston. "The air they breathe gets filtered, but it is then recycled many times, which can cause the accumulation of potentially harmful contaminants. We need a way to tell us when the air is polluted and to help us pinpoint the source."

For example, if the device detects halon, a chemical used in fire extinguishers, it might suggest equipment leakage. On the other hand, increasing levels of a chemical generally found in lower concentrations might indicate a failure in the air-cleaning system.

Mass spectrometers on the market typically weigh about 100 pounds and take up the space of a car trunk.

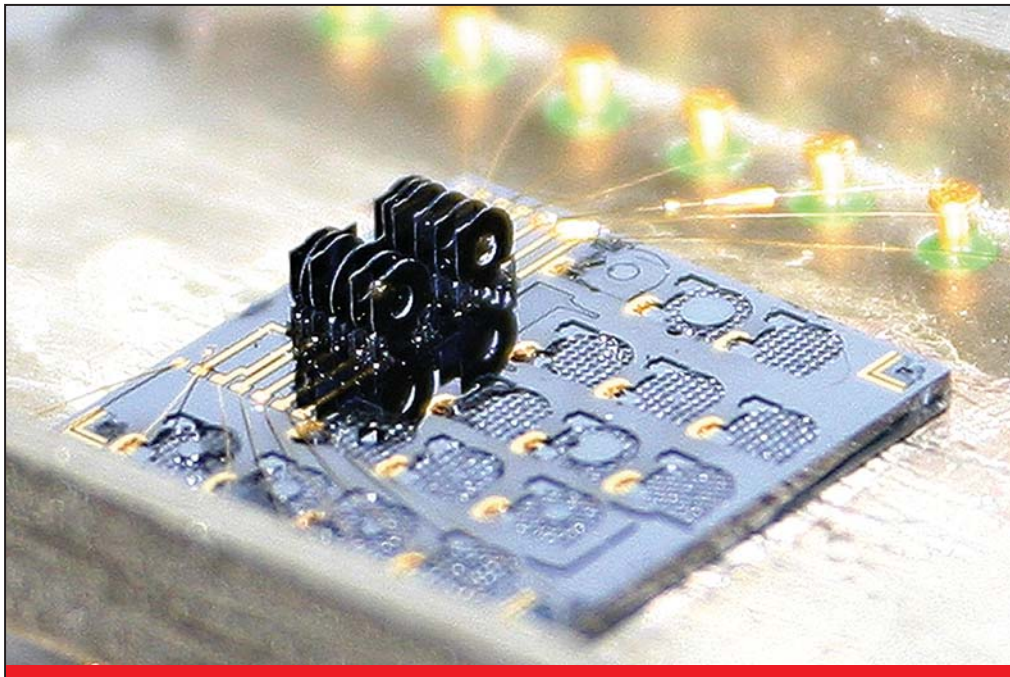
Manufacturers have reduced some mass spectrometers to suitcase size, but these are still too large for space use.

As NASA prepares to return to the moon and explore other planets, the agency needs a device that fits inside a lunar habitat or Mars spacecraft and can monitor the atmosphere with immediate results.

SPACEHAB has teamed up with Zyvex Corp., which specializes in nanotechnology, to reduce the size of available mass spectrometers.

"Developing, transporting and installing large, complex detection and classification equipment in orbit is extremely problematic," says Michael E. Bain, SPACEHAB's chief operating officer. "We are excited about this opportunity to provide a solution that is small, lightweight and portable enough to be easily delivered to, and operated anywhere humans live and work in space."

PHOTO CREDIT: JSC



NASA will begin testing miniature mass spectrometers that can detect and measure pollutants. The resulting development of a compact, portable system that monitors air contaminants may help clear the air in spacecrafts and homes.

> "In general, the air inside a house is dirtier than the air outside... Advancing technologies for space can serve us on Earth, just as the many innovations that came out of NASA's first missions to the moon did and still do today."

Researchers aim to reduce the equipment's size to that of a deck of cards while increasing accuracy and response time. Lower manufacturing costs might reduce purchase costs of the advanced air-quality systems.

The new technology also may have applications on Earth. Smaller monitoring devices might be useful for security measures to detect chemicals or locate explosives. Advances in air-quality monitors may improve the detection of unsafe levels of carbon monoxide and formaldehyde, a common chemical found in new furnishings and carpeting, in homes.

"In general, the air inside a house is dirtier than the air outside," James says. "Advancing technologies for space can serve us on Earth, just as the many innovations that came out of NASA's first missions to the moon did and still do today."

Under the non-reimbursable Space Act Agreement negotiated with SPACEHAB through Johnson Space Center's Technology Transfer Office, NASA research and facilities will join with private-industry expertise to enhance the development of the technology. ■

For more information, contact Butch Hosler, Johnson Space Center, (281) 483-7372, william.b.hosler@nasa.gov.

Please mention that you read about it in Technology Innovation.

Bed Rest Best Medicine for Astronaut Healthcare

The University of Texas, Medical Branch at Galveston (UTMB) and the NASA Johnson Space Center (JSC) in Houston have formed a partnership critical to achieving the new vision for space exploration to the moon, Mars and beyond.

NASA JSC scientists and UTMB medical faculty and researchers have good reason to be excited about the prospects for the long-term health of astronauts in space. Scientists and educators are taking a giant leap in understanding long-term space travel on the human body, without ever having to leave the protection of the Earth's atmosphere.

Bed rest Project Scientist and head of the Cardiovascular Laboratory at NASA JSC Dr. Janice Meck, Project Manager Brad Rhodes and their team are charged with developing and testing countermeasures to alleviate the effects of space travel on the body. With limited access to space flight at this time, long-term bed rest offers scientists the ability to compare, contrast and ameliorate the negative effects of space flight. Bed rest research is not new, but the scientists at NASA JSC have created a new standard for bed rest research that offers scientists and educators a complete picture of the effects on the entire human body. Most previous research has focused only on a single or multiple areas of the body. With this new picture scientists can better understand the effects on the total body including cardiovascular, skeletal, neurological, immune system and others, and can create better remedies to the effects of long-term space travel.

The UTMB bed rest facility, now termed the General Clinical Research Center Satellite Flight Analog Research Unit, is at the heart

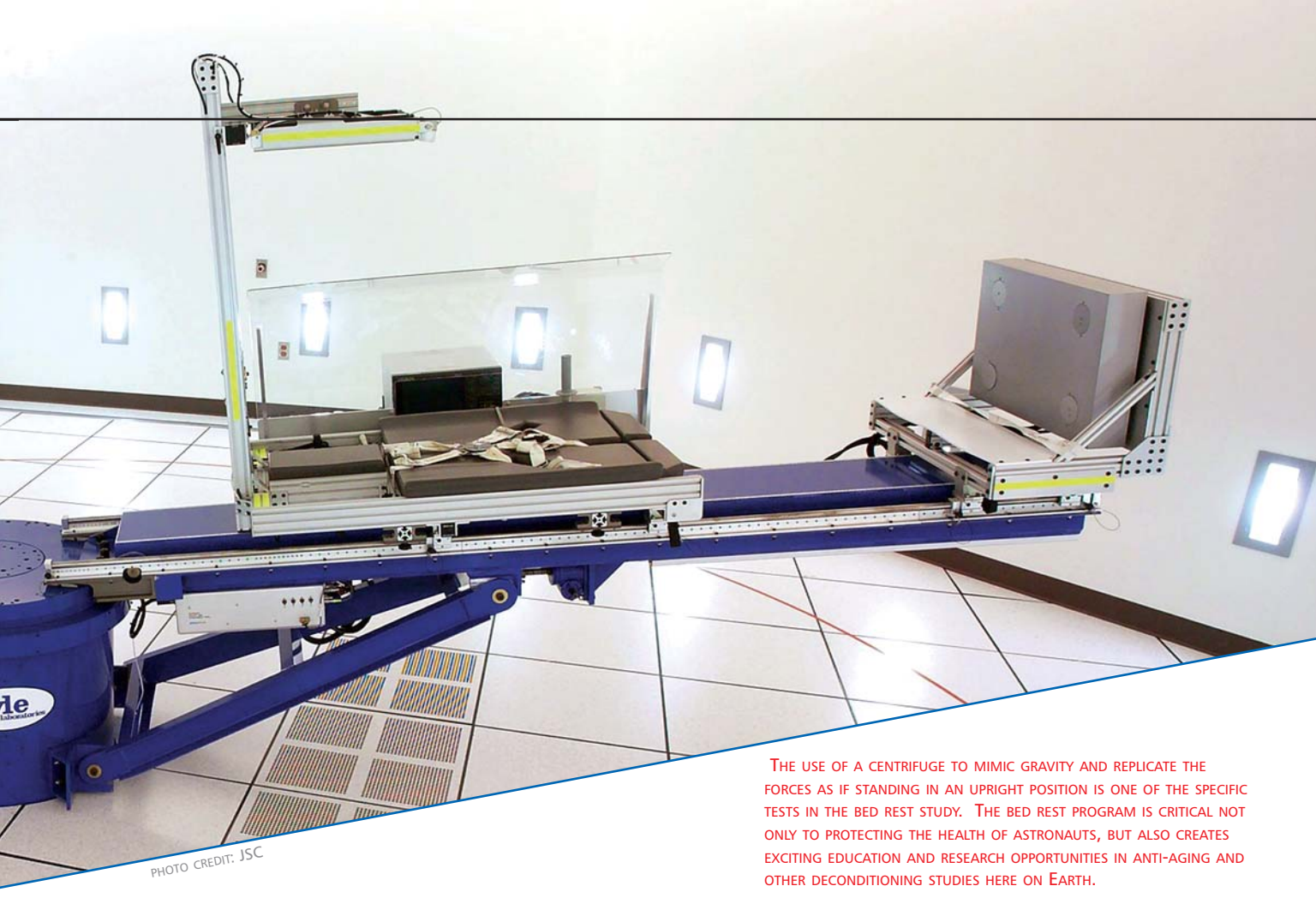


PHOTO CREDIT: JSC

THE USE OF A CENTRIFUGE TO MIMIC GRAVITY AND REPLICATE THE FORCES AS IF STANDING IN AN UPRIGHT POSITION IS ONE OF THE SPECIFIC TESTS IN THE BED REST STUDY. THE BED REST PROGRAM IS CRITICAL NOT ONLY TO PROTECTING THE HEALTH OF ASTRONAUTS, BUT ALSO CREATES EXCITING EDUCATION AND RESEARCH OPPORTUNITIES IN ANTI-AGING AND OTHER DECONDITIONING STUDIES HERE ON EARTH.

of this research. Volunteer subjects, both male and female, are put in a head down tilt bed rest environment for 60-90 days. This position best simulates the displacement of fluids that takes place in the body in the zero gravity environment of space. It also simulates some of the deconditioning effects, particularly on bone and muscle that are seen during space flight. These latest research studies focus on measuring, then countering the negative effects of space flight on the body which includes the diminishing of cardiovascular function, the atrophy occurring in the weight-bearing muscles and skeletal structures, neurological effects and the loss of calcium in bones, to name a few.

Healthcare in Space Can Lead to Anti-Aging Cures Here on Earth

This research is not only critical to the health of astronauts in space, but also offers a promising platform to study the effects of aging on the human body. The National Institute of Health (NIH) funds UTMB's General Clinical Research Center, which supports a variety of clinical research projects, including bed rest studies as part of its aging research. This NASA-funded study on countering the effects of long-term bed-rest may lead to some exciting breakthroughs for the elderly and otherwise bedridden patients.

The partnership between NASA, UTMB and NIH has created a multi-disciplinary standard for the study of bed rest subjects that hold promise for the health of humans in space as well as here on Earth.

Some of the specific tests in the study include the use of various medications to counteract diminished cardiovascular function, the use of exercise to counter muscle and bone atrophy as well as the use of a centrifuge to mimic gravity and replicate the forces as if standing in an upright position. ■

For more information on the UTMB and NASA-JSC Bed Rest Facility, visit http://haco.jsc.nasa.gov/projects/flight_analogs.htm.

Please mention that you read about it in Technology Innovation.

NASA Technology Benefits PT Patients, Soldiers, Children

PHOTO CREDIT: GSFC

In 2003, Connecticut-based Enduro Medical Technology put out a new product called the Secure Ambulation Module (SAM), based upon NASA technology. Since then, the company and its walker for physical therapy have made great strides into the marketplace.

The adult version of SAM is now in use at Walter Reed Army Medical Center in Washington, D.C., as well as at Kindred Hospital of Greensboro, N.C. A youth version called SAM-Y also has been introduced.

The SAM walker provides a safe, stable, standing environment by placing the user in a pelvic harness connected to the wheeled frame. The key to SAM's success is a cable-compliant joint mechanism developed at Goddard Space Flight Center. Originally used in robotics research at Goddard, the technology provided compliance when robots needed to grip or join objects, having enough "give" to keep the contact forces low while generating enough counter-force to activate sensors. Enduro licensed Goddard's cable-compliant technology as well as an early version of the walker and developed SAM as well as a device called the Sit-to-Stand.

These devices are now improving the lives of our nation's soldiers. At Walter Reed, SAM is being used to help patients with traumatic injuries to the spinal cord and brain. "These patients require their leg muscles to be rebuilt or have had their leg muscles start to atrophy while recovering from major surgeries," explains Enduro's president Ken Messier. "The stories of the assistance these soldiers are getting from SAM are quite remarkable."

One active military patient who was wheelchair-bound for two years due to a thoracic spinal cord injury is now up and walking with SAM. "When we first put him in the walker, he was up and going for 25 minutes," says Messier. "He's now walking for up to 25 minutes every day and even using SAM to perform exercises to strengthen his leg muscles."

Former Army sergeant Herbert Geddis of Springfield, Va., used the SAM walker as an integral part of his recovery from neurosarcoid, a rare disease that afflicted his spine, taking away all of his lower body muscle strength. "The SAM walker prevented my knees from buckling and helped me regain my mobility," says Geddis. "I was able to graduate to the therapy on the parallel bars a lot quicker as a result."

Physical therapists at Kindred Hospital have discovered yet another use for the device. "We use SAM with bariatric patients—individuals who are remarkably

Opposite Page: Michael McCahan, a student at C.T. Reed Elementary in Lanham, Md., uses the youth version of the Secure Ambulation Module (SAM-Y) while attending Space Day at Goddard Space Flight Center. He is assisted by Ken Messier, president of Enduro Medical Technology. SAM-Y provides a safe, stable, standing environment by placing the user in a pelvic harness connected to the wheeled frame.

overweight," says Mark Castleberry, director of rehabilitation services. "We have two SAMs, and are currently using one to aid a gentleman who is over 600 pounds."

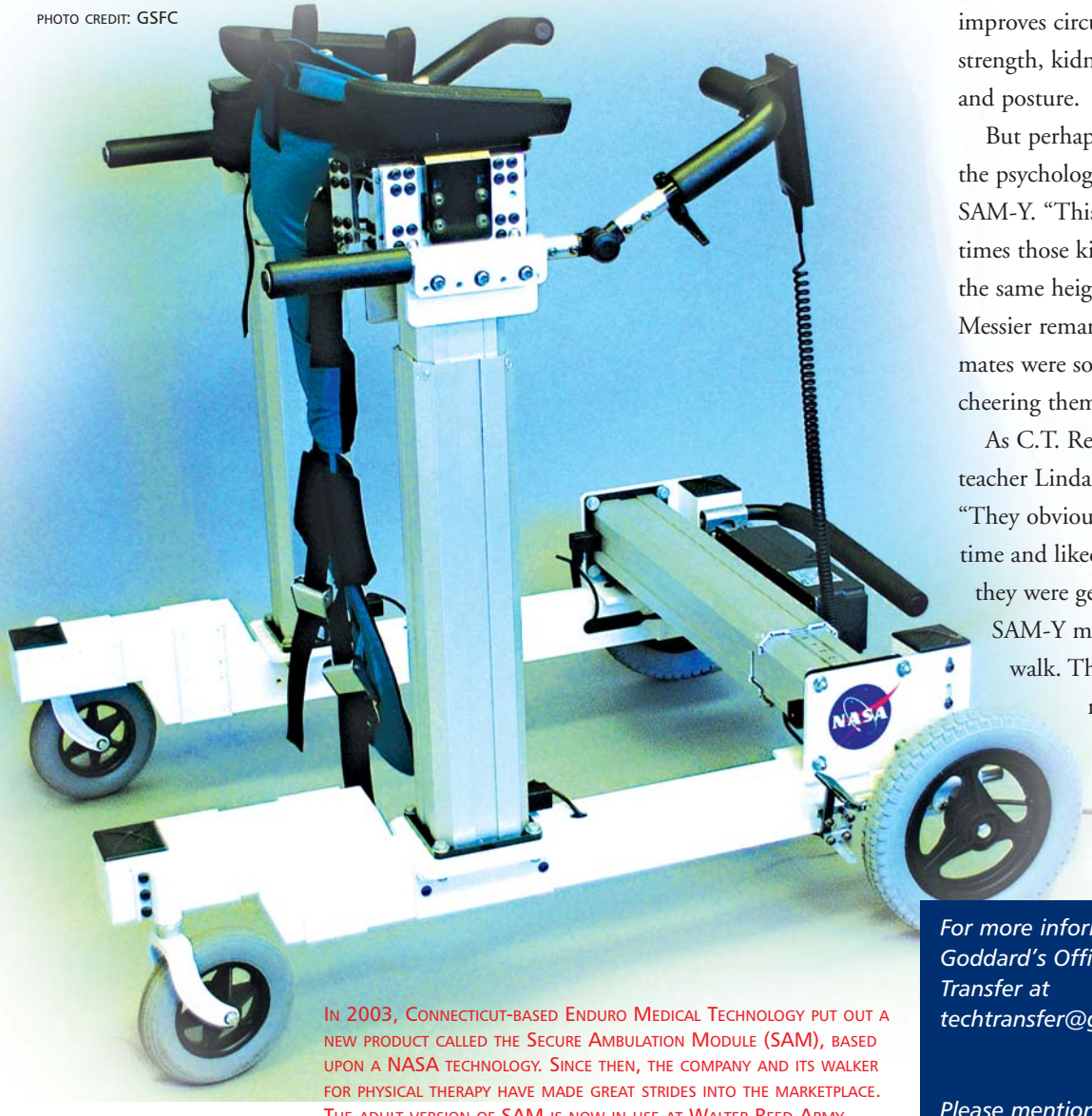
Castleberry explained that "bariatric patients in long-term acute facilities like ours are bedridden and have not used their legs for quite some time. Their legs cannot support their body weight, preventing them from rising to a standing position or walking on their own." Using SAM reduces the pressure on the legs and allows them a chance for increased exercise until they are strong enough to stand on their own. "SAM helps us to help them strengthen their whole lower body," says Castleberry.

But adults are not the only ones who can benefit from the SAM technology. At Space Day, an event at Goddard for sixth graders, Enduro demonstrated SAM-Y. "We probably had at least 50 kids try SAM-Y, including three who were in wheelchairs," says Messier. By allowing children otherwise confined to a wheelchair to stand, SAM-Y improves circulation, trunk strength, kidney and lung function, and posture.

But perhaps more important are the psychological benefits offered by SAM-Y. "This was one of the few times those kids were able to be at the same height as their peers," Messier remarked. "Their classmates were so excited, they were cheering them on."

As C.T. Reed Elementary School teacher Linda Turner observed, "They obviously were having a good time and liked all the attention that they were getting. I think that the SAM-Y made it easier for them to walk. They both could stand up much straighter and did not seem to take as much effort as with their walkers." ■

PHOTO CREDIT: GSFC



IN 2003, CONNECTICUT-BASED ENDURO MEDICAL TECHNOLOGY PUT OUT A NEW PRODUCT CALLED THE SECURE AMBULATION MODULE (SAM), BASED UPON A NASA TECHNOLOGY. SINCE THEN, THE COMPANY AND ITS WALKER FOR PHYSICAL THERAPY HAVE MADE GREAT STRIDES INTO THE MARKETPLACE. THE ADULT VERSION OF SAM IS NOW IN USE AT WALTER REED ARMY MEDICAL CENTER IN WASHINGTON, D.C., AS WELL AS AT KINDRED HOSPITAL OF GREENSBORO, N.C.

For more information, contact Goddard's Office of Technology Transfer at techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Did you know?

An interesting fact to stimulate the mind

What NASA discovery has helped cut down on highway and airport runway accidents?

Concrete Grooves

NASA researchers determined that cutting thin grooves across concrete runways reduces the risk of hydroplaning. The grooves, which create channels for excess water to drain, have been shown to improve aircraft friction performance in wet conditions by 200 to 300 percent. As a result, hundreds of commercial airports around the world have their runways grooved. This technique is now used nationwide on highway curves and overpasses, pedestrian walkways, ramps and steps. The use of grooves on highways has contributed to a reduction in highway accidents.

Propulsion Systems Laboratory

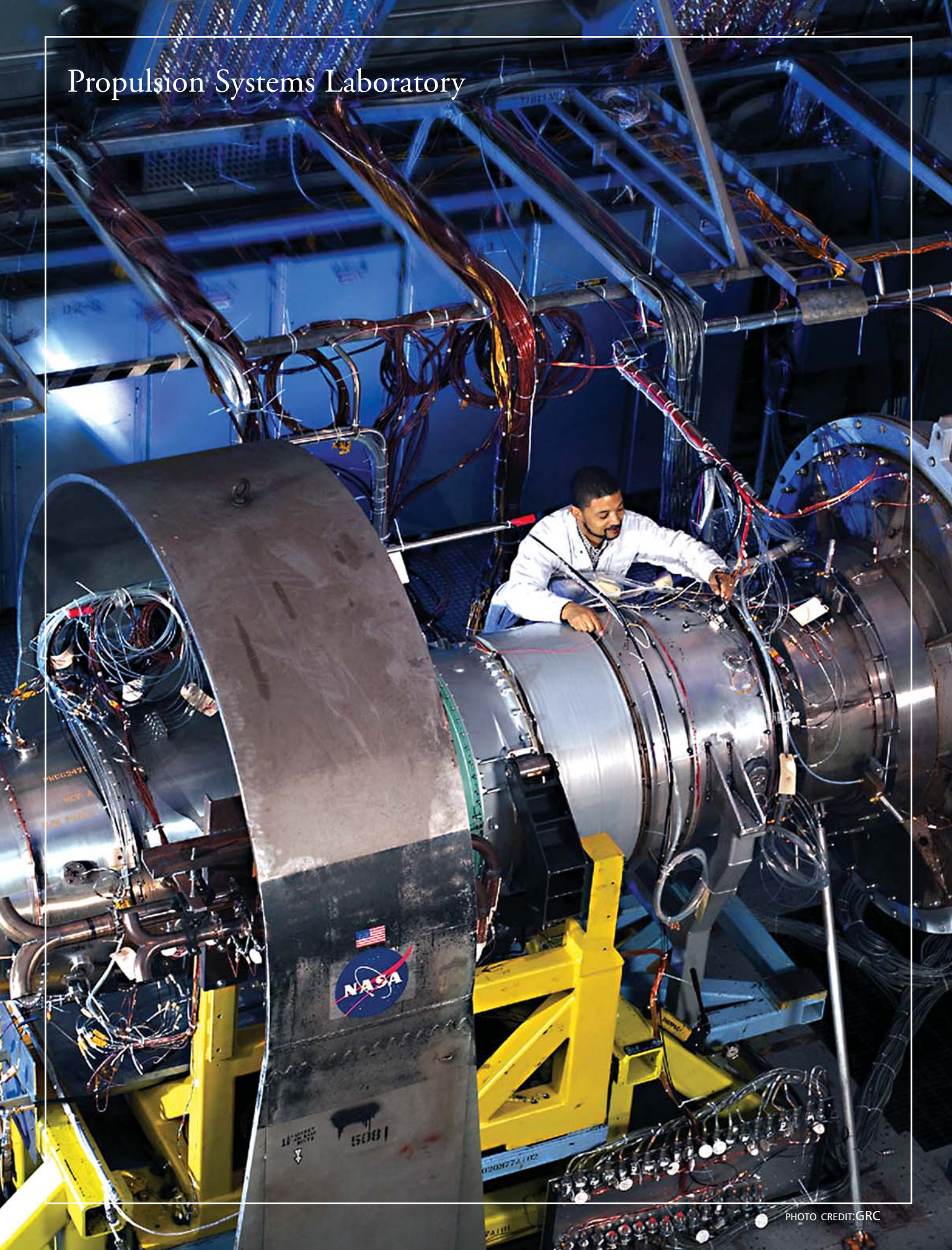


PHOTO CREDIT: GRC

Facility Focus

HIGHLIGHTING A NASA FACILITY THAT PROVIDES FUNCTION BEYOND SPACE EXPLORATION

Propulsion Systems Laboratory (PSL)

The Propulsion Systems Laboratory at Glenn Research Center is NASA's only ground-based test facility that can provide true flight simulation for experimental research on air-breathing propulsion systems. The Propulsion Systems Laboratory (PSL) complex provides world-class test and evaluation capabilities in support of NASA's research and testing mission and charter. Built in the early 1970's, PSL has hosted a number of unique programs that have furthered engine research technologies.

Altitudes to 90,000 feet and Mach numbers to 3.0 in one cell and 6.0 in the other can be simulated continuously. Engine airflow is available to 480 lb/s at an inlet pressure of 55 psia or to 380 lb/s at 165 psia. Inlet temperature control also is available. Real-time display and post-test data reduction are available for all measured and calculated parameters.

The PSL is a highly versatile test facility developed to suit the one-of-a-kind testing common to NASA aeronautics research and testing programs. This versatility allows quick reaction to changes in program direction, as well as complete flexibility to pursue new goals that arise unexpectedly from ongoing experimental research.

Unique concepts in altitude engine testing have been pioneered and perfected in the PSL, such as multiaxis thrust measurement, vectored and reverse exhaust gas collection, infrared imaging at altitude, aeroelastic measurements, transient pressure and/or temperature distortion simulation and flight transient simulation. Recognizing innovation, other test organizations have asked to share PSL's expertise.

PHOTO CREDIT: GRC

THE PROPULSION SYSTEMS LABORATORY AT GLENN RESEARCH CENTER IS BEING UTILIZED TO TEST A PF405 ENGINE.

To initiate using the PSL at NASA Glenn, interested parties should complete and submit a test request form available online at http://facilities.grc.nasa.gov/psl/psl_test_request.html. The form also is available in electronic format for offline submission. ■

For more information, visit http://facilities.grc.nasa.gov.

Please mention that you read about it in Technology Innovation.

OPPOSITE PAGE: AN ENGINE IS BEING SET UP FOR TESTING IN THE PROPULSION SYSTEMS LABORATORY AT GLENN RESEARCH CENTER.

NANOTECHNOLOGY

Holds Promise for Medical Treatment on Earth and in Space

PHOTO CREDIT: JSC

Through a partnership with outside researchers and scientists, NASA Johnson Space Center in Houston is uncovering exciting new technologies that not only will protect the health of astronauts in space, but also hold great promise for the detection and early treatment of illness and disease on Earth.

This partnership began with a vision from U.S. Rep. John Culberson, R-Texas. With support from U.S. Sen. Kay Bailey Hutchison, R-Texas, the congressman believed that combining Houston's vast resources in education and research was key to capitalizing on nanotechnology to solve medical challenges.

Nanotechnology holds great potential in the miniaturization of critical technology, including nanomaterials delivering targeted, preventative medicines to diseased areas of the body. For Johnson, using nanotechnology in the body pre-dosed with medicines to predict health risks and automatically administer appropriate medicines will enable astronauts to lead healthy, productive

A researcher spends time in the nanotechnology laser lab working to develop innovations that will solve medical challenges in space and on Earth.

lives during long-term space travel.

Johnson's objective of creating long-lasting preventative and treatment therapies utilizing nanotechnology dovetails with that of the Alliance for NanoHealth (ANH). The ANH, consisting of seven world-class research institutions, scientists and clinicians, is the first multidisciplinary, multi-institutional collaborative research endeavor aimed solely at using nanotechnology to bridge the gaps between medicine, biology, materials science, computer technology and public policy. Formed against the backdrop of two of Houston's strengths—medicine and nanotechnology—the ANH is committed to providing new clinical approaches to saving lives through better diagnosis, treatment and prevention of illnesses.

Coinciding with the formation of the alliance was the introduction of the National Nanotechnology Initiative, which strengthens scientific disciplines and creates critical interdisciplinary opportunities. For this initiative, the government earmarks several billion dollars

PHOTO CREDIT: JSC

RESEARCHERS ARE WORKING TO UNCOVER NEW TECHNOLOGIES THAT NOT ONLY WILL PROTECT THE HEALTH OF ASTRONAUTS IN SPACE, BUT ALSO HOLD GREAT PROMISE FOR THE DETECTION AND EARLY TREATMENT OF ILLNESS AND DISEASE ON EARTH.

for the research and trial of the use of nanotechnology.

Looking to further NASA's initiative in deep space exploration, Johnson partnered with the ANH to develop improved technology for the remote monitoring and health care of astronauts, whose bodies are prone to tremendous strains because of extended space travel. In addition, the time line for realizing the full benefits envisioned by nanomaterials—10 to 15 years—scales well with Johnson's projected schedule for returning to space.

One of the research challenges facing the ANH-Johnson partnership is how to utilize nanotechnology, in the form of nanotubes, to administer medicines to astronauts to diminish the negative effects of radiation, which they are exposed to during space travel.

Advances in terrestrial medicine also are on the partnership's research agenda. One area being examined is the use of nanotubes to identify diseased areas of the body long before current methods can diagnose the disease.

Success is being seen in an approach to cancer therapy involving a new nanotechnology. Nanospectra Biosciences, a company started from research out of Rice University, is using gold nanoshells to identify and target tumors. Gold nanoshells are administered into the body and heated with an external light; when the nanoshells light, they kill the tumor. This directed thermal ablation targets and kills the cancer, whereas current radiation and chemotherapy spreads damage throughout the body. Nearly one in 10,000 molecules actually makes it to the site of the cancer, so in many cases more damage is done by the toxic chemotherapy than the cancer itself. Nanospectra's nanoshell technology is in pre-clinical validation now, and initial results already have shown it to be successful in live mice.

The ANH member institutions are the University of Texas Health Sciences in Houston, Rice University, University of Houston, University of Texas M.D. Anderson Cancer Center, Baylor College of Medicine, University of Texas Medical Branch in Galveston and Texas A&M University. The two-year-old alliance focuses on three areas of research: nanotechnology, bio-analytics and bioinformatics. Two of the most promising areas are targeted therapeutics, such as the work underway at Nanospectra Biosciences, and molecular imaging, whose applications include injecting nanomaterials into the body to identify and treat diseased areas. The ANH also is committed to recruiting the talent and acquiring the investment necessary to promote nanotechnology in the Houston area. ■

For more information, visit www.nanohealthalliance.org.

Please mention that you read about it in Technology Innovation.

A Lesson In...

Software Agreements

NASA's mission is enhanced by expanding partnerships between NASA and industry firms and by leveraging the venture capital community for innovative technology development. One of the partnering options is a Software Agreement.

Software Usage Agreements and Licenses are used to transfer software to academia, industry and other federal agencies. Licenses are agreements that are negotiated between two or more parties for commercialization of software in a specific field of use, or for a specific purpose.

A Software Usage Agreement (SUA) is an agreement for use of a piece of software. Depending on the stage of development and NASA mission related goals, SUAs are used for beta-testing software, delivering software to partners who have existing grants, contracts, cooperative agreements and Space Act Agreements, and for use of software by other federal agencies, commercial entities and academia. ■

For more information, visit www.ipp.nasa.gov.

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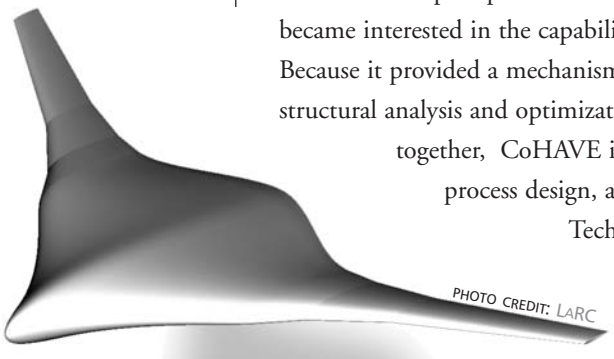
Innovative Research

Technosoft Develops Software Product with SBIR Assistance

Imagine a software product that is continuously evolving, and with each progression, there are new features and enhancements that help you do your job better. Researchers at NASA Langley Research Center (LaRC) in Hampton, Va., are already using such an innovation.

In the early 1990s, Technosoft Inc., a small company in Cincinnati, developed software called Adaptive Modeling Language (AML) for the United States Air Force. AML was created to save time and money during the design and engineering process of building a vehicle. Simply put, AML is a framework — an underlying architecture — on which applications can be built.



Software developed by Technosoft Inc., provides an underlying architecture on which applications can be built. With the assistance of the Small Business Innovation Research program, the technology continues to evolve and is useful to government and industrial entities.

Based on the Air Force's success with the software, Technosoft knew that it also would be useful to others with similar research initiatives, such as NASA. Air Force officials helped pave the way for the firm to meet with innovators at LaRC.

A researcher from the Air Force Research Lab was working collaboratively with the group on different projects to learn best practices in vehicle design. The researcher recommended using Technosoft's AML.

John Martin of the Vehicle Analysis Branch (VAB) says, "We were skeptical at first. We'd invested quite a bit of time into developing our own code for collaborative applications, but it didn't perform that well."

"The AML software also came with extensive corporate knowledge, and that was a real plus for us," says Shelly Ferlemann, another VAB branch researcher.

Their skepticism aside, Technosoft eventually received a Small Business Innovation Research (SBIR) contract from Langley to further develop the software. Working with the LaRC team, Technosoft built a Collaborative Hypersonic Air-breathing Vehicle Design Environment, also known as "CoHAVE," on their AML framework. CoHAVE was being used to look at scramjet/ramjet engine based vehicles for 2-stage to Earth orbit and hypersonic cruise missions.

NASA aerospace partners like Boeing and Lockheed Martin became interested in the capabilities of the enhanced software. Because it provided a mechanism for different disciplines like structural analysis and optimization to collaboratively work together, CoHAVE improved the product and process design, and saved time and money. Technosoft was ahead of schedule on the software's development, and by the time the company was into an SBIR Phase 2 contract, the product was already being used in design processes. The success of CoHAVE led to a Phase 3 contract from Langley for the firm. Ferlemann is sold on using Technosoft for their applications.

"It's great for knowledge-capture. You don't have to start from scratch. The tools make it easy for new users to run it. They're then more productive quickly. Before it would take days to generate the same data. With Technosoft's visualization features, mistakes are evident right away and can be corrected before a project gets too far along," says Ferlemann.

EXAMPLES OF HOW NASA IS WORKING WITH SMALL BUSINESSES

Martin and Ferlemann also like the fact that the software can run on any computer, and they're able to take models from elsewhere and do quick system analysis studies.

Partnering with Langley on CoHAVE has helped Technosoft to further evolve the AML product. "A lot of the technology developed within the SBIR has transitioned to general purpose technology within our environment," says Chemaly.

Building on CoHAVE's capabilities, the firm has developed a subsequent product called Adaptive Modeling, Rapid Air Vehicle Engineering Environment (AMRaven). NASA, Boeing and Lockheed Martin are currently using it.

Today, Technosoft is continuing to expand on CoHAVE and bring partners together for other vehicle design projects. At Langley, CoHAVE has morphed into "ADVISE" (Advanced Vehicle Integration and Synthesis Environment), because the branch's research scope has been broadened to meet the Agency's space exploration needs.

By leveraging the work they've done so far, the company won a large contract from the Air Force and has subcontracted Langley as their partner on the work. Hilmi Alkamhawi, a Technosoft software engineer, is currently working on site with Martin and Ferlemann.

The firm also demonstrated AML and CoHAVE for the Navy and are now partnering on submarine design.

Based on the AML framework, the firm has created design environments for other applications, such as an interactive missile design for the military. They've been able to transition it to commercial industries as well, like automotive and trucking, and structures for oil and gas.

Today, the original work with NASA has been widely deployed to the Agency's partners.

"Presently, there are more than 14 programs at Lockheed that have directly or indirectly used some of the results from our NASA SBIR," says Chemaly.

When it comes to developing software, Technosoft likes the challenge of trying to solve what seem to be impossible design problems, and so users of its software will continue to benefit from future evolutions of Technosoft products. ■

For more information, contact
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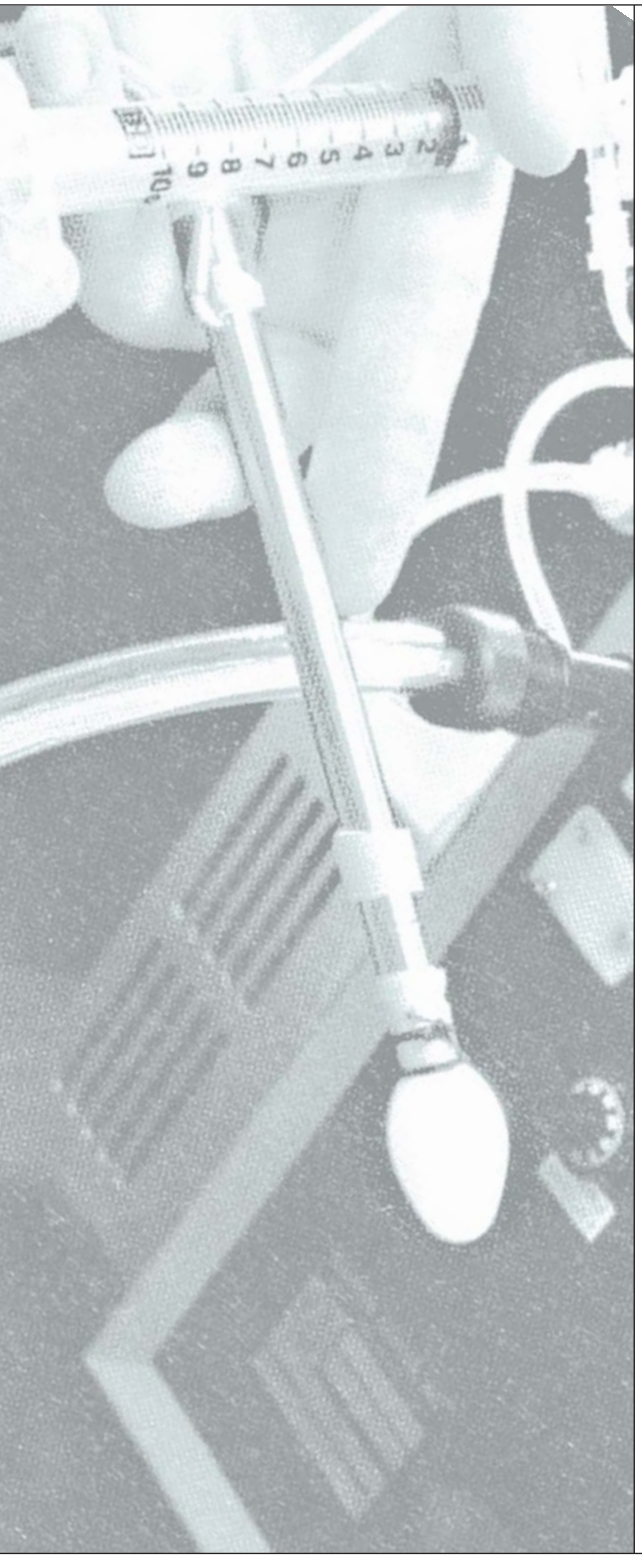
Please mention that you read about it in Technology Innovation.

"One NASA" Peer Award Presented to SBIR/STTR Program Management Office

Members of the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program management office recently were honored for mission success utilizing a "One NASA" approach.

Team members were recognized by their peers for outstanding management of NASA's SBIR and STTR programs in a manner that partners mission directorates, centers small businesses and research institutions to enable NASA's future missions.

The certificates were signed by Edward Weiler, director of Goddard Space Flight Center. ■



Did you know?

An interesting fact to stimulate the mind

Q What type of technology originally developed by NASA for plant growth experiments in space is improving the treatment of brain and skin tumors and other medical problems, such as wounds?

A Photodynamic Therapy

Doctors at the Medical College of Wisconsin are using a new lighting technology to improve a chemotherapy technique called photodynamic therapy. This technique uses focused light to activate medicines that kill cancerous tumors. In the past, photodynamic therapy used a laser light. The new light source is more efficient, versatile, accurate and less costly. NASA and medical practitioners also are investigating the use of this technique to accelerate the healing of wounds both in space and on the ground.

NASA Innovative Partnerships Network

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NASA Business Facilitators

NASA has established several organizations whose objectives are to establish joint-sponsored research agreements and incubate small startup companies with significant business promise.

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NASA-Sponsored Technology Transfer Organizations

These organizations were established to provide rapid access to NASA and other federal R&D agencies and to foster collaboration between public- and private-sector organizations. They also can direct you to the appropriate point of contact within the Federal Laboratory Consortium. To reach the organization nearest you, call 800/642-2872.

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