National Aeronautics and Space Administration

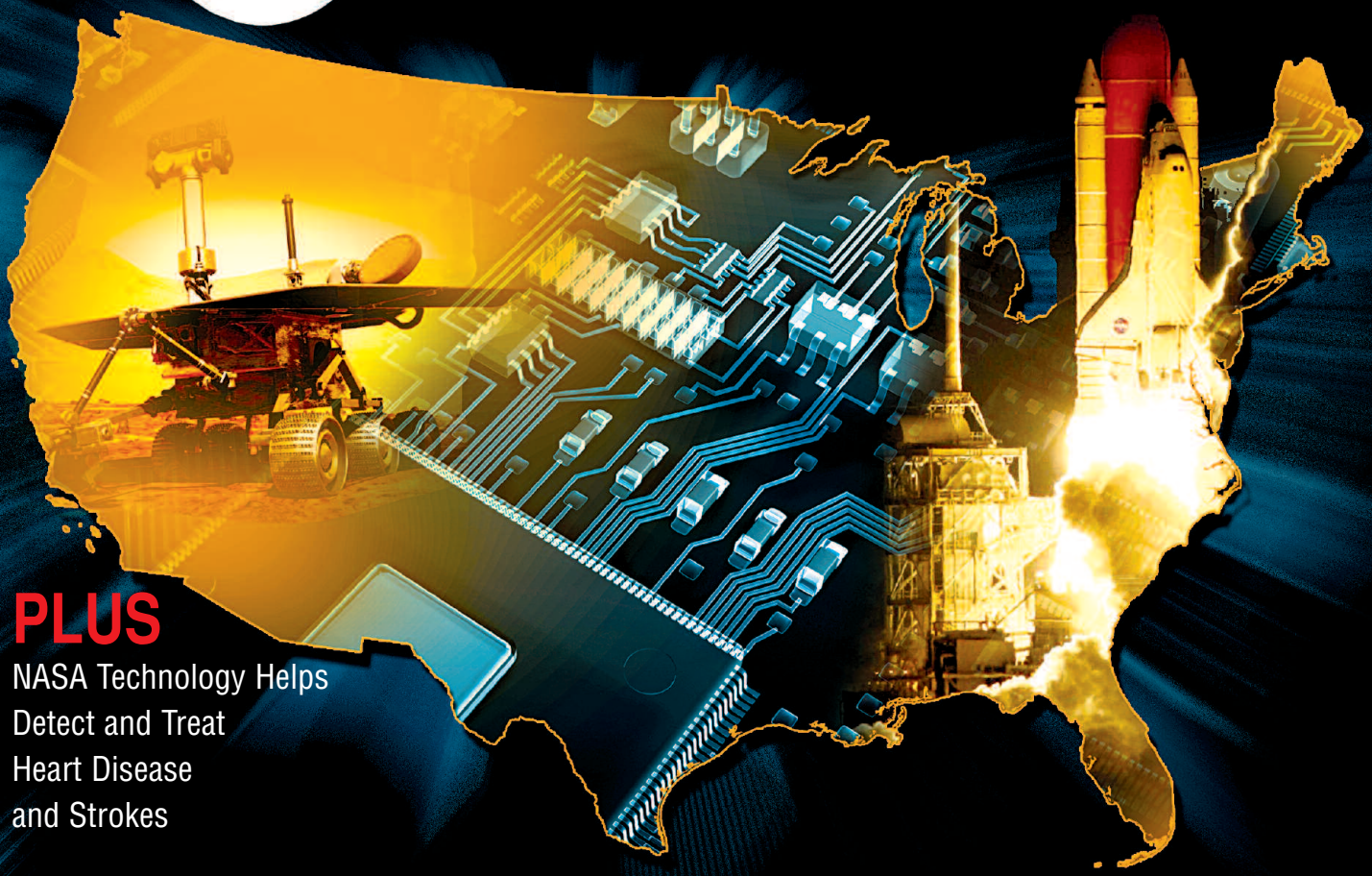
TECHNOLOGY INNOVATION

MAGAZINE FOR BUSINESS & TECHNOLOGY

Volume 14 • Number 1 • 2008

Doing Business With NASA

The Innovative Partnerships Program



PLUS

NASA Technology Helps Detect and Treat Heart Disease and Strokes

Merging Two Powerful Software Tools to Create a One-of-a-Kind Exploration Capability

How You Can Participate in the Space Program

Centennial Challenges

Upcoming Events

Upcoming Events

October 24-25, 2008: Lunar Lander

Holloman Air Force Base, NM

2008 PURSE $2M

Rocket vehicles simulating lunar takeoff and landing

Managed by: X PRIZE Foundation

http://space.xprize.org/

***Fall 2008: Power Beaming and Tether**

Western US

2008 PURSE UP TO $2M EACH

Wireless power transmission and super-strength materials

Managed by: Spaceward Foundation

http://www.spaceward.org/elevator2010-pb

http://www.spaceward.org/elevator2010-ts

***Spring 2009: Astronaut Glove**

TBD

2009 PURSE $400K

Innovative spacesuit glove designs

Managed by: Volanz Aerospace, Inc.

http://www.spaceflightamerica.org

Expires June '09: MoonROx

Competitor's location

PURSE $1M

Producing oxygen from simulated lunar material

Managed by: California Space Education & Workforce Institute

http://moonrox.csewi.org/

*Date and location of event are tentative. For a complete listing of competitions, descriptions and dates please visit:

http://centennialchallenges.nasa.gov/

Learn How Space is in Your Daily Life

COVER STORY

PAGE 12

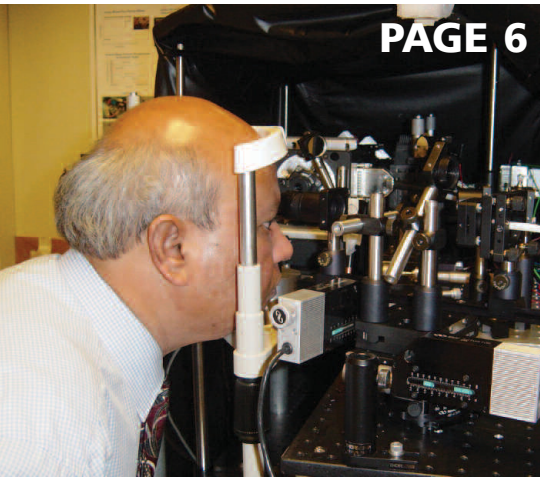
Doing Business With NASA

Through the Innovative Partnerships Program, NASA taps into the vast technical and scientific resources that are so abundant throughout the U.S., and the results benefit not only the Agency, but the entire nation.

feature articles

departments

To view online and for past issues, visit
http://www.ipp.nasa.gov/innovation



TECHNOLOGIES ORIGINALLY DEVELOPED TO STUDY THE BEHAVIOR OF FLUIDS IN MICROGRAVITY ARE BEING USED TO DETECT VARIOUS EYE PROBLEMS AND DISEASES EARLIER AND MORE ACCURATELY THAN EVER BEFORE.

PAGE 35

A SCREENSHOT FROM MICROSOFT'S NEW LIVE™ SEARCH: MAPS* SERVICE. VEXCEL, A RECIPIENT OF STTR FUNDING, DEVELOPED A WIRELESS SENSOR NETWORK TECHNOLOGY THAT WILL HELP THE COMPUTING GIANT PRODUCE RICH, DYNAMIC SETS OF IMAGERY AND DATA THAT WILL BE INTEGRATED INTO LIVE SEARCH.

Chief Editor
Janelle Turner

Managing Editor
Michele Rejonis

Art Director/Production
Dennis Packer

Contributors
Douglas A. Comstock
Kathryn Duda
Carol A. Dunn
Romel D. Gomez
Thomas J. Green
Javed Khan
Dan Lockney
Beth Oldham
Nancy Pekar
William M. Toscano
Debora Wolfenbarger
John Yadvish

Technology Innovation is published biannually by the NASA Innovative Partnerships Program. Your feedback provides important contributions to this publication.

please visit our Web site:
www.ipp.nasa.gov/innovation

UPFRONT with...

Douglas A. Comstock

Director of NASA's
Innovative Partnerships Program

WHAT AN EXCITING TIME TO BE AT NASA!

This year NASA is celebrating 50 years of aeronautics research and space exploration and a legacy of achievements we can all be very proud of. An essential element in many of those achievements has been NASA's ability to catalyze and harness technology innovation, and much of this has been done through partnerships.

Advancing technology through partnerships has always been important to NASA, not only to address NASA's needs, but also to apply NASA-derived technology to a range of applications that provide broad benefit to the public. The mission of NASA's Innovative Partnerships Program (IPP) is to seek partnerships that match technology needs with technology capabilities, moving technology both into (technology infusion) and out of (technology transfer) the Agency. NASA's focus on technology infusion involves tapping into the wellspring of innovation that exists across the country. This method of drawing technologies inward not only helps NASA meet its specific mission goals, but provides value to the external entities partnering with the Agency with funding or partnerships that help mature their technologies.

Some notable successes described in this issue of *Technology Innovation* include:

- A small business is doing big things to advance the space program through funding from NASA's SBIR program. Several SBIR awards have helped Paragon Space Development Corp. to develop technologies that will be integral to the newly awarded spacesuit project.
- Roads and structures around the world are using technology from Kennedy Space Center's Corrosion Technology Laboratory to reduce corrosion in concrete and steel rebar.
- Software developed by NASA's Jet Propulsion Laboratory to analyze images from Mars is now being applied to conduct precise ultrasound imaging to determine carotid artery thickness as an important indicator of heart disease.

There are many opportunities and methods for partnering with NASA, and the cover story in this issue of *Technology Innovation* is dedicated to helping readers identify those opportunities and find the method best suited to their interests and capabilities. As NASA prepares to embark on a bold new chapter in human and robotic exploration there will be many opportunities for small businesses, entrepreneurs, other government agencies, universities and the general public to become involved.

For more details on how to partner with NASA, be sure to read the cover story in this issue, and to visit the IPP Web site at www.ipp.nasa.gov. We look forward to working with you.

NASA News Briefs

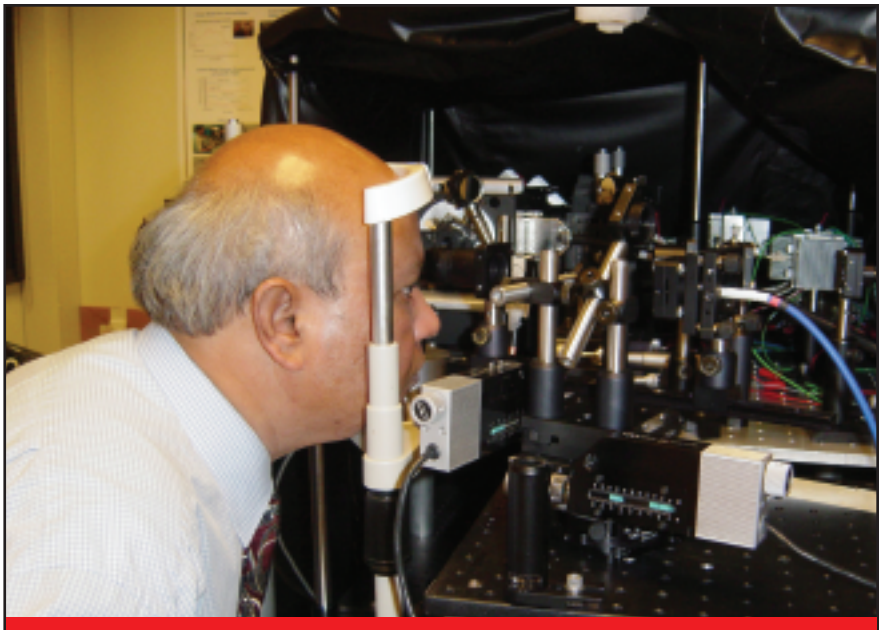
Eye-Opening Science

Americans with vision problems are among the beneficiaries of the eye-opening healing technologies NASA has inspired. Technologies originally developed to study the behavior of fluids in microgravity are being used to detect various eye problems and diseases earlier and more accurately than ever before.

Millions of Americans have been diagnosed with diabetes mellitus, and millions more have the disease and don't know it. That's serious since diabetes can cause many symptoms, including impaired vision and even blindness through cataracts, glaucoma and diabetic retinopathy — damage to the blood vessels at the back of the eye.

Those who develop diabetes-related cataracts are more likely to face surgical removal as the only treatment option. But that is likely to change thanks to groundbreaking research by NASA scientist Dr. Rafat Ansari.

Ansari, now a professor at the University of Texas, became interested in cataracts when his father was diagnosed with them. This interest corresponded well with his work at the NASA Glenn Research Center in Cleveland, where he conducted research on the effects of low gravity on eyes. It turns out that aging and space travel have similar effects on the body – including the development of cataracts. On a long flight to Mars, the clouding of cataracts could have devastating effects, therefore NASA is interested in spotting their development as soon as possible.



TECHNOLOGIES ORIGINALLY DEVELOPED TO STUDY THE BEHAVIOR OF FLUIDS IN MICROGRAVITY ARE BEING USED TO DETECT VARIOUS EYE PROBLEMS AND DISEASES EARLIER AND MORE ACCURATELY THAN EVER BEFORE.

Ansari's team developed a new instrument, similar to night-vision goggles, which is able to spot the telltale signs of a developing cataract long before its clinical symptoms appear. The instrument has a lot of potential use in preventive health here on Earth. Ansari, who sees the eye as the "window to the body," is even using his instrument to search for signs of Alzheimer's disease.

Ansari's instrument is one more example of NASA driving innovation for the Agency's space exploration needs, resulting in technologies that have the potential for breakthrough applications here on Earth. ■

For more information, contact Laurel Stauber, (216) 433-2820, laurel.j.stauber@nasa.gov.

Please mention that you read about it in Technology Innovation.

NASA TECHNOLOGY TRANSFER AND INDUSTRY-RELATED NEWS

Nanotechnology Biochips Provide Early Warning

NASA Ames Research Center, Moffet Field, Calif., and Early Warning, Inc., have executed both a Space Act Agreement and a License regarding Ames' miniaturized electronics technology or nanotechnology "Biosensor" with extremely high sensitivity for in-vitro detection of a specific biomarker signature.

This revolutionary nanotechnology-based sensor can detect trace amounts of specific bacteria, viruses and parasites. This is accomplished by embedding vertically aligned carbon nanotubes as nanoelectrode arrays in diagnostics devices.

Under this new collaboration, NASA and Early Warning plan to further develop the technology to create a new generation of the biosensor to be used as a component in a biochip that incorporates the new biosensor with microfluidics, chemical reagents, heater, electrodes and harsh environment packaging. This new biosensor will be capable of detecting and identifying up to 100 different micro-organisms in less than 30 minutes. The biochip will be part of a product to identify trace amounts of disease causing microorganisms such as bacteria, viruses, protozoa, metazoa or fungi in drinking water. The initial applications will be for a portable biodetection device, a wireless biodetection network and a consumer testing device.

The spread of microbial pathogens between people, animals, food and microorganisms is unprecedented in the history of the world and will continue to rise rapidly. While it is impossible to reverse these trends in the coming decades, the most effective way to limit the massive health and economic consequence of pathogens is the early detection of the pathogens at both the points of source in the environment and the points of entry to populated areas and the food chain. This will allow pathogens to be rapidly contained and be removed cost effectively before mass transmission of pathogens can take place to attack humans and devastate the environment and food chain. With respect to the economic impact of microbial pathogens and the related infectious diseases, the estimated costs of outbreaks are likely to reach hundreds of billions of dollars in the coming century based on extrapolations of past outbreaks including HIV/AIDS, plant diseases, SARS outbreak, Mad Cow Disease and e-coli.

A family of Early Warning products, integrating the biochip collaboratively developed with NASA, will be developed for environmental and food processing, homeland security and possible medical applications. The hardware will be designed in modules where the biochip module based on NASA patented technology is used to measure pathogens in samples collected from multiple input types (water, air, surface contaminants, etc.) and for use in either a portable testing device or a wireless sensor network.

The low-cost biochips are particularly desirable for pathogen monitoring and biomarker detection in NASA's space exploration missions, mitigating the need for the large and expensive supporting facilities used in today's clinical laboratories. NASA will further benefit by having a commercial source for off-the-shelf (COTS) biochip, portable device, and wireless network products for space missions at a great cost savings.

The partners in this collaboration report that an important lesson learned is that projects such as this one require patience and flexibility. They coordinated for more than a year and worked aggressively to resolve many issues and concerns.

Early Warning has activities in Mountain View, Calif.; Salt Lake City; Manhattan, Kan.; Montreal and Waterloo. ■

For more information, contact William Toscano, (650) 604-0894, wmtoscano@mail.arc.nasa.gov.

Please mention that you read about it in Technology Innovation.

NASA's Corrosion Technology Laboratory

Corrosion Protection for Space and Beyond

Advances in corrosion protection being developed at NASA's Corrosion Technology Laboratory located at Kennedy Space Center (KSC), Florida, will have a wide-reaching impact on corrosion prevention for various non-space applications like bridges and buildings. Since the establishment of NASA's Launch Operations Center at KSC in 1962, the spaceport has served as the departure gate for every American human mission and hundreds of advanced scientific spacecraft under the Launch Services Program. Today, NASA is on the edge of a bold new challenge: the Constellation Program. The ambitious new endeavor calls for NASA to return human explorers to the Moon and then venture even farther, to Mars and beyond.

As the nation's premier spaceport, KSC will play a critical role in this new chapter in exploration, particularly in the conversion of the launch facilities to accommodate the new launch vehicles. To prepare for this endeavor, the launch site and facilities for the next generation of crew and cargo vehicles must be redesigned, assembled and tested. One critical factor that is being carefully considered during the renovation is protecting the new facilities and structures from corrosion and deterioration.

A Resource for Corrosion Research

NASA began corrosion studies at the KSC in 1966 during the Gemini/Apollo Programs with the evaluation of long-term protective coatings for the corrosion protection of carbon steel. The KSC environment near the launch pads has been documented by the American Society of Materials (ASM) as one of the most corrosive, naturally occurring, environments in the world. Research and development of technologies that offer corrosion protection and prevention at the launch facilities is high on NASA's priority needs list.

To combat the harsh environment, NASA established the Corrosion Technology Laboratory at KSC. This facility has complete capabilities for corrosion research and testing. Scientists and engineers at Kennedy's Corrosion Technology Laboratory are working to reduce the impact of corrosion and even develop new corrosion-prevention technologies as NASA prepares KSC for the Constellation Program.

The facilities of NASA's Corrosion Technology Laboratory include a beachside atmospheric exposure site, an electrochemistry and coating development laboratory, an accelerated corrosion laboratory, a coatings application facility and a photo documentation laboratory. The beachside atmospheric exposure site includes a full weather data station, a cathodic protection compatibility tank, seawater immersion tanks, and an on-site laboratory, in addition to the numerous racks for atmospheric exposure. This site has been actively maintained for more than 40 years and has generated a historical database for evaluation of new materials. The site has remote access network connectivity for data acquisition and real time video by the Internet. These facilities are available to companies and individuals outside of NASA, and can provide a way for the finishing industry to advance corrosion-resistant technologies.

Corrosion-Resistant Coating Advances

Corrosion in concrete is a major concern in areas with marine environments like the space center. The Corrosion Technology Laboratory has developed technology to protect both concrete and steel rebar in concrete. KSC's two shuttle launch sites each consist of 68,000 yd^3 of concrete weighing 1.3 million pounds. As these two launch pads are being reconstructed to accommodate the manned Ares I (Crew Launch Vehicle) and the unmanned Ares V (Cargo Launch Vehicle) in support of the Constellation Program, the lab will continue developing technology to protect these structures. Recently, a sacrificial galvanic coating was developed to

PHOTO CREDIT: NASA KSC

COATED PANELS UNDERGO RIGOROUS TESTING AT THE KSC ATMOSPHERIC CORROSION TEST SITE. THE FACILITIES AT THE CORROSION TECHNOLOGY LABORATORY ARE AVAILABLE TO COMPANIES AND INDIVIDUALS OUTSIDE OF NASA. THEY CAN PROVIDE A WAY FOR THE FINISHING INDUSTRY TO ADVANCE CORROSION-RESISTANT TECHNOLOGIES.

prevent the corrosion of steel rebar in concrete. NASA licensed the patented technology to Cortec Corp., of White Bear Lake, Minn., and Pittsburgh-based Surtreat, a Delaware corporation. The coating is currently being reformulated and tested on structures throughout the world. For details on these partnerships see www.sti.nasa.gov/tto/Spinoff2007/er_4.html and www.sti.nasa.gov/tto/Spinoff2004/p_4.html.

Luz M. Calle, an innovator at KSC, offered the following advice for individuals and companies interested in such a partnership: communication among all partners in a timely fashion is critical; personal contact and visits to the different locations involved in a project are very helpful; partners should be patient and be prepared to deal with unexpected changes in schedule and funding; flexibility and capability to adapt are very important; having a plan and a schedule of milestones and deliverables is critical to the success of a project.

NASA uses different types of coatings to protect flight hardware, launch pad structures and ground support equipment. Barrier coatings, such as epoxies and urethanes, are used to isolate the surface of a metal structure from the corrosive environment. Conversion coatings, such as the Super Koropon primer used for corrosion protection of areas throughout the orbiter, convert the surface into a hard, durable, corrosion-resistant layer. And sacrificial coatings, such as the zinc-rich primers used at the launch pads, offer corrosion protection by corroding in preference to the carbon steel.

These coatings sense the environment and provide an appropriate response. The Corrosion Technology Laboratory is currently developing smart coatings for corrosion detection and control at an early stage to prevent further corrosion. The lab is also involved in the development of self-cleaning photocatalytic coatings that remove contamination without human intervention.

A Better Understanding

The Corrosion Technology Lab and its work are considered unique within NASA. New procedures have been developed for rapidly evaluating corrosion-resistant alloys, protective coatings and other materials, thereby enhancing the safety and reliability of the nation's launch infrastructure and flight hardware. Results of this research will benefit the new structures for launch. For example, Launch Complex 39B will undergo the beginnings of its conversion to the Ares I facility with the building of three to four new tall lightning masts, followed by a stripping of the pad of the fixed and rotating service structures currently used to access the shuttle and insert payloads into the orbiter. The launch complex will resemble the Apollo-like "clean pad" design for the first time since 1977. Two new moveable launch platforms and a launch tower will be constructed to accommodate the Ares I, and a new "roller coaster" escape system, replacing the existing slide wire system, will connect the launch tower with a new fortified bunker located 1,000 meters from the pad. Fortifying the new platforms, tower and escape system with

continued

alloys and protective coatings will greatly enhance the safety and reliability of this equipment.

KSC corrosion experts use test equipment such as acidic and standard salt spray chambers, weatherometers, AC and DC electrochemical corrosion instrumentation, adhesion testers, data loggers and other instrumentation to conduct research on the corrosion behavior of materials in various environments, including the interiors of the processing facilities and on transport equipment. The Vehicle Assembly Building is currently undergoing modifications to accommodate the simultaneous assembly and checkout operations for both the shuttle and for the Ares I. Eventually, the building will allow for the assembly of both an Ares I and Ares V when lunar missions commence after 2018. NASA will also build two new mobile launch platforms designed to handle the Ares I with the current crawler-transporters and will eventually replace the Apollo-era machines with new units when the Ares V comes on-line. Corrosion-resistant materials are vital to sustain the operability and life of these structures.

Current projects in the Corrosion Technology Laboratory also support the future development of space vehicles by examining technology that will prevent corrosion of materials in the space environment. Results of these projects will help protect vehicles launching from a third launch complex NASA is considering — 39C — which will be used primarily to accommodate future Mars missions when more than one Ares V would be required to launch the Mars-bound spacecraft into low-Earth orbit.

As NASA prepares to move forward, the Corrosion Technology Lab at KSC will continue to provide a better understanding of the corrosion processes affecting NASA's redesigned launch sites, structures, facilities and launch vehicles. Such knowledge will undoubtedly benefit other applications and the future finishing industry as a whole. ■

For more information, contact Luz Marina Calle, (321) 867-3278, luz.m.calle@nasa.gov or visit http://corrosion.ksc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Texas Instruments Uses NASA Facility to Test Advanced Spaceflight Electronics

As part of a Space Act Agreement (SAA), Texas Instruments (TI) will work with researchers at NASA Goddard Space Flight Center's Radiation Effects Facility (REF), Greenbelt, Md., to test and reengineer electronics that can withstand the effects of radiation in space. The agreement will enable TI to understand what would be required to engineer and market radiation-tolerant electronics to serve NASA and aerospace companies that manufacture spaceflight equipment. As the feature sizes of space electronics become smaller, the agreement will also help both organizations understand the radiation effects of scaling space electronics as well as the impact on test methodology.

Benefits of Technology Transfer

TI will receive radiation test data from NASA researchers, enabling the company to reengineer and validate the radiation tolerance of its spaceflight electronics.

TI can gain a competitive advantage by choosing to market radiation-tolerant spacecraft equipment to NASA and other aerospace companies.

If testing results are positive, NASA will have access to improved radiation-tolerant spacecraft electronics produced by TI, benefiting current and future missions as well as long-term satellite operations.

NASA will be able to apply test data to other space electronics to understand the impact of its current test methodologies on various sizes of instruments.

Both organizations, as well as other government agencies will benefit from understanding whether current test methodologies are adequate for testing current and future electronics.

About Texas Instruments

TI is a leading innovator of digital signal processing and analog technologies for semiconductors. Headquartered in

Dallas, the company has more than 30,000 employees worldwide with corporate, sales and manufacturing facilities in more than 25 countries. Founded more than 70 years ago, TI began making semiconductors for the signal processing markets in 1996.

About Goddard's Radiation Effects Facility (REF)

The REF was established in the 1960s to study ionization and displacement damage of electronics and materials as well as instrument calibration requirements for devices in space. Functional and parametric performance changes occur at different ionization levels in space, making the REF's radiation-damage testing vital for a variety of aerospace equipment, including electronics, microcircuits, sensors, couplings, lenses and filters as well as paints, coatings and aircraft structural materials. The facility also produces and calibrates sensors, X-ray machines and other radiation measurement instruments. Because space missions often expose materials and electronics to substantial degrees of radiation, precise measurement of their radiation tolerance is critical to help ensure the safety and longevity of long-term space operations (such as satellites on Mars).

The Transfer Process

The SAA between TI and NASA was negotiated and administered by Goddard's Innovative Partnerships Program Office. Already a leading producer of semiconductors, TI was interested in designing electronics for space applications.

Goddard's Ken LaBel approached TI researchers about evaluating the company's emerging technologies at the REF. The SAA gives TI access to not only Goddard's radiation testing and validation facilities but also the Center's on-site expertise.

Looking Ahead

Having entered into an agreement with NASA, TI is well positioned to successfully build and market spaceflight-ready electronics. The company plans to provide Goddard researchers with current models of its transistors, semiconductor parts and other electronics with possible space application. Researchers at Goddard will radiate and electronically test these components at the REF to measure how much radiation they can withstand. In turn, TI will use this data to reengineer the parts to compensate for any failures, with the goal of demonstrating new models that will withstand expected radiation levels in space. The testing will also enable researchers to begin building a test database to record the impact of scaling technologies on radiation effects so that NASA and other organizations can develop appropriate testing methodologies for various device sizes.

Lessons Learned

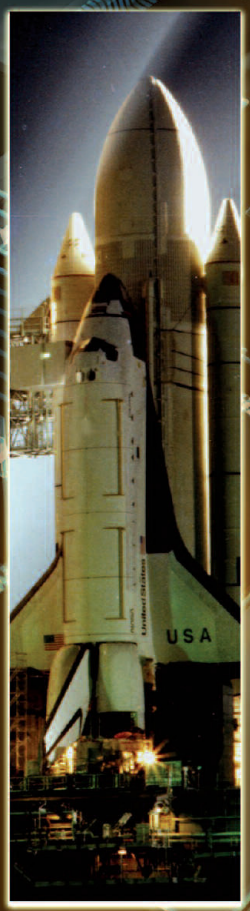
According to Texas Instruments officials, the biggest lesson learned was to assemble a list of GSFC requirements of what is needed in terms of documentation of the silicon that the commercial partner provided. At first it was handled as many separate requests but found that asking NASA for a "laundry list" of requirements (layout documentation, specific process documentation, operating conditions, etc.) would aid getting all the critical information to the teams actually doing the testing. From the commercial vendor's point of view, a clearly defined list of expectations is helpful in determining the scope of the work and what can and cannot be done.

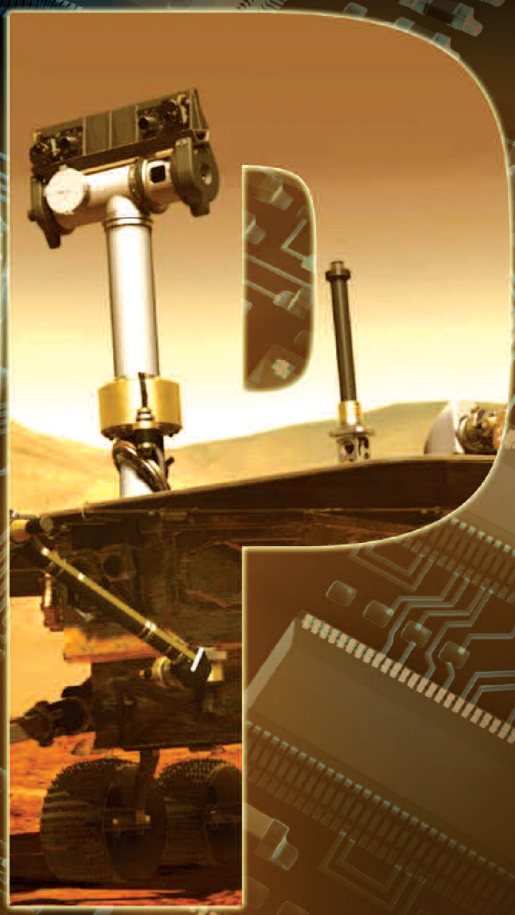
Regarding the usefulness or advantages of this interaction - they are as follows from the Texas Instruments point-of-view: NASA did heavy ion and proton irradiations of Texas Instruments parts which the company did not have to do, resulting in a cost savings. The results showed single event latchup (SEL) at high linear energy transfer (LET) for ions, which was the first time Texas Instruments had observed this in test chips. This data is being used with a University program in an attempt to simulate SEL occurrence for the development of design rules prior to fabrication silicon devices. Additionally, proton results revealed high single event upset (SEU) cross-sections at low energy, confirming that advanced technologies may be susceptible to lower energy events as compared with previous technologies. This has important ramifications for the use of advanced commercial off-the-shelf components (COTS) in space environments. ■

For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Doing Business With NASA





By Douglas A. Comstock
Director, NASA Innovative Partnerships Program

For 50 years, NASA has been tackling complex technology issues on the way to the Moon and to other worlds far beyond our own. And while NASA is fertile ground for cutting-edge innovations, solutions to many of these challenges are found outside the Agency.

Through its **Innovative Partnerships Program** (IPP), NASA taps into the vast technical and scientific resources that are so abundant throughout the U.S., and the results benefit not only NASA, but the entire nation.

By way of investments and partnerships with industry, academia, government agencies and national laboratories, the Innovative Partnerships Program (IPP) provides the technologies and the capabilities that are needed by NASA's programs and projects, and by its Mission Directorates — the four NASA business units responsible for investments in flight missions and technical projects to achieve the Agency's goals in space exploration, space science, aeronautics and space operations.

As one of NASA's mission support offices, IPP supports all four Mission Directorates and has program offices at each of the agency's 10 Field Centers.

IPP consists of the following program elements:

- Technology Infusion, which includes the Small Business Innovative Research (SBIR)/Small Business Technology Transfer (STTR) programs and the IPP Seed Fund;
- Innovation Incubator, which includes Centennial Challenges and efforts such as Innovation Transfusion and facilitating the purchase of services from the emerging commercial space sector; and
- Partnership Development, which includes Intellectual Property Management and Technology Transfer, as well as new innovative partnerships.

Together, these program elements increase NASA's connection to emerging technologies in external communities, enable targeted positioning of NASA's technology portfolio in selected areas, provide NASA with technology solutions, enable cost avoidance, accelerate technology maturation and secure NASA's intellectual property rights to provide fair access and to support NASA's strategic goals.

Technology transfer through dual-use partnerships and licensing also creates many important socio-economic benefits within the broader community.

The following information is meant to serve as a guide to explore partnerships with NASA.

Technology Infusion

Small Business Innovative Research/Small Business Technology Transfer

The SBIR/STTR programs, as established by law, exist to stimulate technological innovation in the private sector; to strengthen the role of small businesses in meeting federal research and development needs; to increase the commercial application of these research results; and to encourage participation by socially and economically disadvantaged persons and women-owned small businesses.

How Companies Can Participate

NASA conducts an annual competitive selection process. For a proposal to be eligible for selection, it must describe an innovation that meets the technology needs of NASA programs and projects, and it must have significant potential for successful commercialization. In this context, commercialization is defined as the transition of technology into products and services for NASA mission programs, for other government agencies and for non-government markets.

The annual period for NASA's solicitation of SBIR/STTR proposals is generally early July through early September. NASA's Mission Directorates help define the areas of research and technology contained in the solicitation, and the areas may vary in content from year to year, depending upon NASA's current needs.

Details on participating in NASA's SBIR/STTR program can be found online at http://sbir.nasa.gov or at www.ipp.nasa.gov. These sites also document successful commercial applications of NASA SBIR technologies in private and government markets.

Investment Seed Fund

The IPP Seed Fund enhances NASA's ability to meet mission technology goals by providing seed funding to address barriers and to initiate cost-shared, joint-technology development partnerships. Seed Fund projects encourage, to the maximum extent possible, leveraging of funding, resources and expertise from non-NASA partners, NASA programs and projects and NASA Field Centers.

In the last two years, an IPP investment of $15.9 million in the Seed Fund facilitated the generation of 67 partnerships and was leveraged by

PHOTO CREDIT: NASA

DOUGLAS A. COMSTOCK, DIRECTOR OF NASA'S INNOVATIVE PARTNERSHIPS PROGRAM, ANNOUNCES THE WINNER OF THE ASTRONAUT GLOVE CHALLENGE, THE FIRST PRIZE AWARDED AS A PART OF THE CENTENNIAL CHALLENGES COMPETITION.

nearly a factor of four, providing a total of $62.2 million for the advancement of critical technologies and capabilities for the Agency. The 2006 and 2007 Seed Fund winners are listed on the IPP Web site: http://ipp.nasa.gov/ti_seed_fund.htm.

How Outside Organizations Can Participate

The IPP Office at NASA Headquarters provides a Seed Fund call for proposals to NASA Centers on an annual basis if funds are appropriated. The call solicits proposals for cost-shared partnerships with industry, academia, research institutions, national laboratories and other government agencies for joint development of technology that is of mission interest to NASA. The call is developed in coordination with all Mission Directorates to identify particular technology gaps to address and is distributed to all Field Centers.

An announcement is posted on the FedBizOpps Web site at www.fbo.gov, soliciting external interest in partnering. Interested organizations should contact a relevant Field Center to discuss concepts, and responses must be from a designated NASA Partnership Manager (PM) in a Field Center IPP Office.

Proposals must include both an internal NASA Co-Principal Investigator (Co-PI) and an External Co-PI, and are generally due to the appropriate NASA Field Center about four months after the call goes out. Exact dates and other helpful information can be found at http://ipp.nasa.gov/ti_seed_fund.htm.

Proposed projects should have a one-year duration and must include one or more non-NASA partners who are willing to provide cost sharing at a level equal to or greater than the IPP funding provided to the project. Acceptable cost sharing from the partner includes actual dollars applied directly to the project and in-kind consideration such as workforce labor and the use of unique and dedicated facilities and test-beds, but not sunk costs.

Proposals are evaluated against criteria that include relevance/value to NASA Mission Directorates; scientific/technical merit and feasibility; and leveraging of resources.

The review process takes about two months and begins at each of NASA's 10 Field Centers, where proposals are prioritized for submission to NASA Headquarters. All Mission Directorates are involved in prioritizing proposals received at Headquarters, according to the needs of each Mission Directorate. The NASA Headquarters IPP Office makes final selections.

Innovation Incubator

Centennial Challenges

The Centennial Challenges program presents awards for completed novel technological solutions related to solar system exploration and other ongoing NASA mission areas. Innovations are sought from non-traditional sources in academia, industry and the public.

NASA has partnered with five different allied organizations, which conduct Centennial Challenge competitions at no cost to NASA, and the Agency provides the prize money. To date, NASA's allied organizations have conducted nine competitions, and NASA has awarded prize money for two. The first prize was awarded in May 2007 with the Astronaut Glove Challenge.

How Outside Organizations Can Participate:

Check the IPP Web site, www.ipp.nasa.gov, or the Web sites of the individual allied organizations, which are listed here with their corresponding challenges and the current prize purses:

- The X PRIZE Foundation: $2 million Lunar Lander Challenge
- Volanz Aerospace, Inc./ Spaceflight America: $400,000 Astronaut Glove Challenge
- The Spaceward Foundation: $2 million Tether Challenge; and $2 million Beam Power Challenge
- California Space Education & Workforce Institute (CSEWI): $1million Moon Regolith Oxygen Extraction (MoonROx) Challenge; and, $750,000 Regolith Excavation Challenge
- Comparative Aircraft Flight Efficiency (CAFE) Foundation: $300,000 General Aviation Technology Challenge

Facilitated Access to the Space environment for Technology development and Training (FAST)

FAST is an initiative to provide partnership opportunities involving technology development that relies on limited exposure to the microgravity environment. The initiative uses the services of a recent contract between NASA's Glenn Research Center and Zero Gravity Corporation to provide commercial parabolic aircraft flight services to simulate multiple gravity environments. FAST will purchase services through this new procurement mechanism.

FAST has the dual objectives of demonstrating the purchase of commercial services from the emerging commercial space sector, and advancing technology maturity through use of those services.

As commercial suborbital flights become available, the FAST project will seek to use those services as well – initially for technology development and eventually to support potential training needs. FAST may eventually look to incorporate 'shared rides' on sounding rockets or orbital vehicles, and space-environment training facilities. The goal is to eventually extend the commercial space service procurement model to a standard business practice within NASA.

IPP's process for selecting technology development partnerships for microgravity flight services will be similar to the IPP Seed Fund selection process, and include the Mission Directorates to help prioritize technology needs.

FAST has the dual objectives of demonstrating the purchase of commercial services from the emerging commercial space sector and advancing technology maturity through use of those services.

How Outside Organizations Can Participate

In the Fall of 2008, the NASA Headquarters IPP Office will release a call for proposals for cost-shared partnerships targeted at SBIR/STTR technologies and Seed Fund project technologies, and inviting new partnerships with industry, academia, research institutions, national laboratories and other government agencies. The objective is joint development of technology that is of primary interest to NASA and that will advance the technology after successful demonstration in the appropriate reduced-gravity environment. Assessment of possible partners will be conducted through NASA Mission

Directorates and the NASA Field Center IPP offices.

Also, a release on the FedBizOpps Web site (www.fbo.gov) will solicit interest from possible external partners. Proposal submission is coordinated through the IPP office at each Field Center, and interested parties should contact Field Center IPP offices to learn more about how to be considered for partnership opportunities. The NASA Headquarters IPP office makes the final selection of proposals and partners, after evaluation by the four Mission Directorates.

Field Center IPP offices will manage the partnerships. The focus will not be on new developmental work for the technology, but rather on advancing the technology through microgravity flights aboard the parabolic aircraft. See www.ipp.nasa.gov/ii_fast.htm.

PHOTO CREDIT: NASA

A PARABOLIC FLIGHT SIMULATES MULTIPLE GRAVITY ENVIRONMENTS FOR NASA'S FAST PROGRAM. FAST IS AN INITIATIVE TO PROVIDE PARTNERSHIP OPPORTUNITIES INVOLVING TECHNOLOGY DEVELOPMENT THAT RELIES ON EXPOSURE TO THE VARIABLE OR MICROGRAVITY ENVIRONMENT.

Innovation Transfusion

Through this new program element, IPP will create connections between innovative external organizations and NASA for increased Agency benefit from external creativity.

The objectives of the Innovation Transfusion project are to identify strategic areas of innovation with potential benefit to NASA, recognize and learn from current innovations occurring outside the Agency, broadly disseminate external innovations internally to NASA, foster future partnerships and provide innovation focus to career development.

Innovation Transfusion contains the following two major components:

- Innovation Ambassadors program, which places technical employees at external organizations for approximately 3 to 12 months to work on achieving the goals and objectives set forth in their individual development plans.
- Innovation Scouts program, in which IPP staff and technology experts will visit innovative organizations for focused one- or two-day workshops to exchange information on specific innovations and to gather information regarding the host organization's latest technology developments.

Ambassador selection and scout workshops scheduling will occur on an annual schedule, with the goal of incorporating innovations into NASA to meet Agency needs.

How Companies Can Participate

Contact NASA Field Center IPP Chiefs (see listing on page 39 of this issue), and visit individual Web sites of Field Center IPP offices.

Partnership Development

Technology Transfer – Technology Infusion (Transfer In)

With limited resources for technology development within NASA, it has become increasingly important for the Agency to bring in, or infuse, technology developed jointly in partnerships with industry, academia, other federal agencies and other external entities.

Accordingly, IPP's portfolio of program elements facilitates and provides for leveraging of partner expertise and funds to develop technologies critical

to NASA's mission R&D goals. Sources of technology in the IPP portfolio include SBIR/STTR, Centennial Challenges, the IPP Seed Fund and dual-use technology development partnerships.

The spectrum of technologies critical to NASA's missions is very broad, and it has roots and applications in a broad range of industrial, academic and government sectors. Therefore, opportunities exist for non-NASA entities in many sectors to partner with NASA to advance their own interests as well as those of the Agency. Internal resources of both NASA and its partners is thereby leveraged to the advantage of both in creating, maturing and adapting technologies for dual-use purposes.

By surveying the technology and technology-needs landscapes inside and outside of NASA, IPP identifies potential matches. To identify NASA's technology needs, the IPP works closely with NASA's Mission Directorates.

The principal partnership agreement mechanism is the Space Act Agreement (SAA), although other agreement types are possible. NASA determines the appropriate agreement instrument (see table on page 20). An imperative is that the partnership agreement's objectives include mission benefit to NASA. Exclusivity is generally not given in SAAs or other agreements.

The following factors are critical to infusing any technology into NASA missions:

Performance considerations

- Demonstrated impact of the technology on overall system performance (e.g. power savings, higher resolution, mass or volume reduction, improved safety and reliability) and the ability to quantify benefits.
- Demonstrated technical ability and experience of the technology developer.

Schedule considerations

- Partner's demonstrated ability to bring the necessary physical and financial resources to bear in a timely way.
- Consistency of the current maturity of the technology and a realistic technology development plan with the technology need date.
- Identifiable opportunities for possible acceleration of maturity and deployment of the technology.

Cost considerations

- Reasonable costs and realistic estimates of cost of developing and infusing the technology.
- Comparison of costs to other technology options.
- Opportunities to reduce costs for additional development through partnerships.

Risk considerations

- Current state of maturity of the technology in the context of its development history and projections for its future development.
- The extent to which competing technologies are well understood and commonly used.
- Strength of the benefits of utilizing the technology in the specific project as well as applicability of the technology to other projects.
- Unequivocal demonstration of the technology.
- The technology's having an active NASA champion.
- Realistic risk mitigation strategies

PHOTO CREDIT: NASA

The Beam Power Challenge is one of the many competitions in the Centennial Challenges program.

regarding all aspects of risk associated with infusing the technology.

Technology Transfer – Licensing (Transfer Out)

Over the course of its history, IPP has originated and negotiated licenses and related partnerships with the private sector to facilitate the transfer of NASA-developed technologies for commercial application and other public benefits. These benefits have permeated the U.S. and international economies, as the resulting commercial products — more than 1,600 of which are documented in NASA's *Spinoff* publication — contributed to the development of services and technologies in health and medicine, transportation, public safety, consumer goods, agriculture, environmental resources, computer technology, manufacturing and other key industrial sectors.

Licensing terms are negotiated on a case-by-case basis, although technology fields of use are defined as narrowly as practical in every case, and exclusive licenses are avoided.

Intellectual Property Management

IPP facilitates the protection of NASA's rights in its inventions, thereby enabling NASA's ability to license its technologies.

To identify technologies that NASA can offer for licensing, NASA inventors — including civil servants and contractors — file New Technology Reports (NTRs) that describe their inventions and corresponding potential applications. The NTRs form the basis for technologies that are communicated to a broad audience through the monthly magazine, *Tech Briefs*. The IPP facilitates the processing of NTRs and provides commercial assessments, which are critical to patenting decisions for inventions reported in NTRs.

How Outside Organizations Can Participate

IPP produces three publications that highlight opportunities for, and results from doing business with NASA.

- *Tech Briefs* includes licensing opportunities available through NASA, as well as unprotected NASA technologies that are available without a fee. *Tech Briefs* also includes a new section featuring selected NASA technology needs for which NASA seeks dual-use development partners. The magazine is targeted to the scientific and technical community and has a readership of 400,000-500,000. *Tech Briefs* is available online at www.techbriefs.com, as well as in hard copy.
- *Spinoff*, published annually and aimed at the general public, features 40 to 50 NASA technologies that have been transferred successfully. In it, companies will find opportunities for strategic alliances with NASA. *Spinoff* is available in print, online through a dedicated Web site at www.sti.nasa.gov/tto and as an interactive CD-ROM. Print copies and the CD can be requested by calling (301)286-7985 or through spinoff@sti.nasa.gov.
- *Technology Innovation* published biannually, provides information about NASA's technology needs and opportunities, as well as interesting facts and feature articles about the Agency's successful partnerships with industry, academia and other government agencies. *Technology Innovation* has a distribution of 15,000 and is available on the Web at www.nasa.gov/innovation.

Additional suggestions for participating include the following:

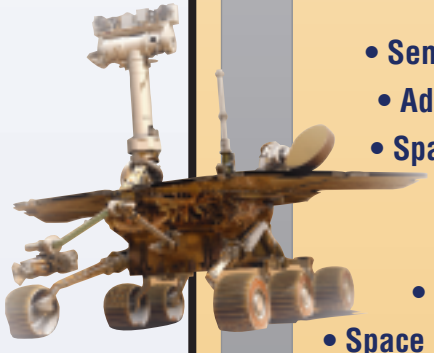
- Contact IPP's NASA Field Center points of contact listed on page 39 of this edition, and visit individual NASA Field Center IPP Web sites for information on NASA technologies available for license.
- Attend or participate in industry technology trade shows in which NASA and other federal agencies participate.
- Stay alert to NASA Industry Days and similar planned events in which NASA informs industry of its technology needs. Details are available at www.ipp.nasa.gov.

The spectrum of technologies key to NASA's missions is so broad that it is difficult to imagine a key industrial sector not having a mutual interest and not being able to benefit from innovations in one or more of NASA's technology areas. The IPP program, through its various program elements, therefore provides the opportunity for a broad spectrum of industry, large and small companies alike, to contribute to NASA's missions and simultaneously enhance their competitive positions in international markets. Indeed, IPP also challenges the ingenuity of individuals, inviting entrepreneurs, inventors and students alike to create innovative technology and thereby contribute to NASA's missions. ■

SUMMARY OF NASA FIELD CENTERS BY TECHNOLOGY AREA

- **Aviation Safety:** ARC, DFRC, GRC, LaRC
- **Fundamental Aeronautics:** GRC, LaRC
- **Airspace Systems:** ARC, LaRC
- **Aeronautics Test Technologies:** GRC
- **Avionics and Software:** ARC, LaRC
- **Sensors for Autonomous Systems:** JSC
- **Environmental Control and Life Support:** GRC, JSC, JPL
- **Extra Vehicular Activity:** GRC, JSC
- **Lunar In Situ Resource Utilization:** JSC
- **Structures, Materials, Mechanisms:** GSFC, LaRC, MSFC
- **Lunar Operations:** GRC, JSC
- **Energy Generation and Storage:** GRC
- **Propulsion and Cryogenic Systems:** GRC, MSFC
- **Protection Systems:** ARC
- **Thermal Management:** JSC
- **Exploration Crew Health Capabilities:** GRC, JSC
- **Space Human Factors and Food Systems:** JSC
- **Space Radiation:** ARC, JSC
- **Sensors, Detectors, Instruments:** GSFC, JPL, LaRC
- **Advanced Telescope Systems:** GSFC, JPL, MSFC
- **Spacecraft and Platform Subsystems:** GRC, GSFC
- **Small Spacecraft:** ARC
- **Robotics:** JPL
- **Information Technologies:** ARC, GSFC, SSC
- **Space Communications and Navigation:** GRC, GSFC, JPL
- **Space Transportation:** KSC, SSC
- **Processing and Operations:** GRC, JSC, KSC
- **Atmospheric Research:** DFRC, LaRC
- **Launch Site Technologies:** KSC
- **Space Transportation:** MSFC
- **Rocket Propulsion Testing:** SSC
- **Integrated Health System Management:** ARC

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

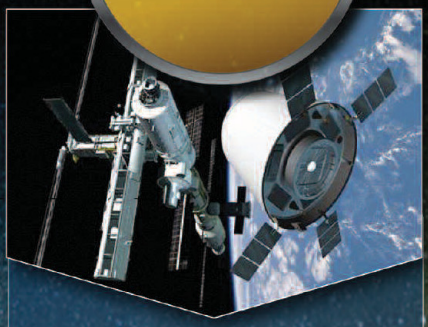


Innovative Partnerships Program Elements

Technology Infusion

- Small Business Innovation Research (SBIR)
- Small Business Technology Transfer Research (STTR)
- IPP Seed Fund

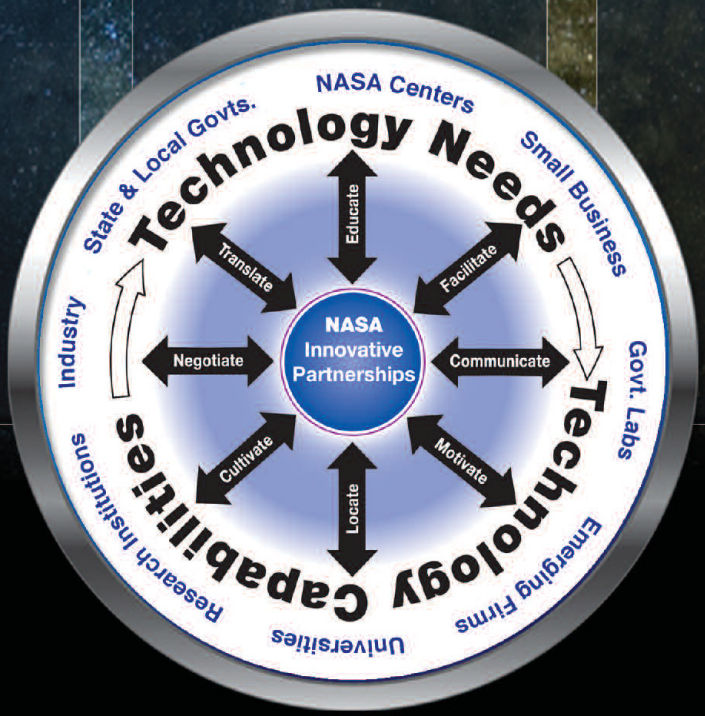
Innovation Incubator



- Centennial Challenges
- FAST
- Innovation Transfusion
- New Business Models

Partnership Development

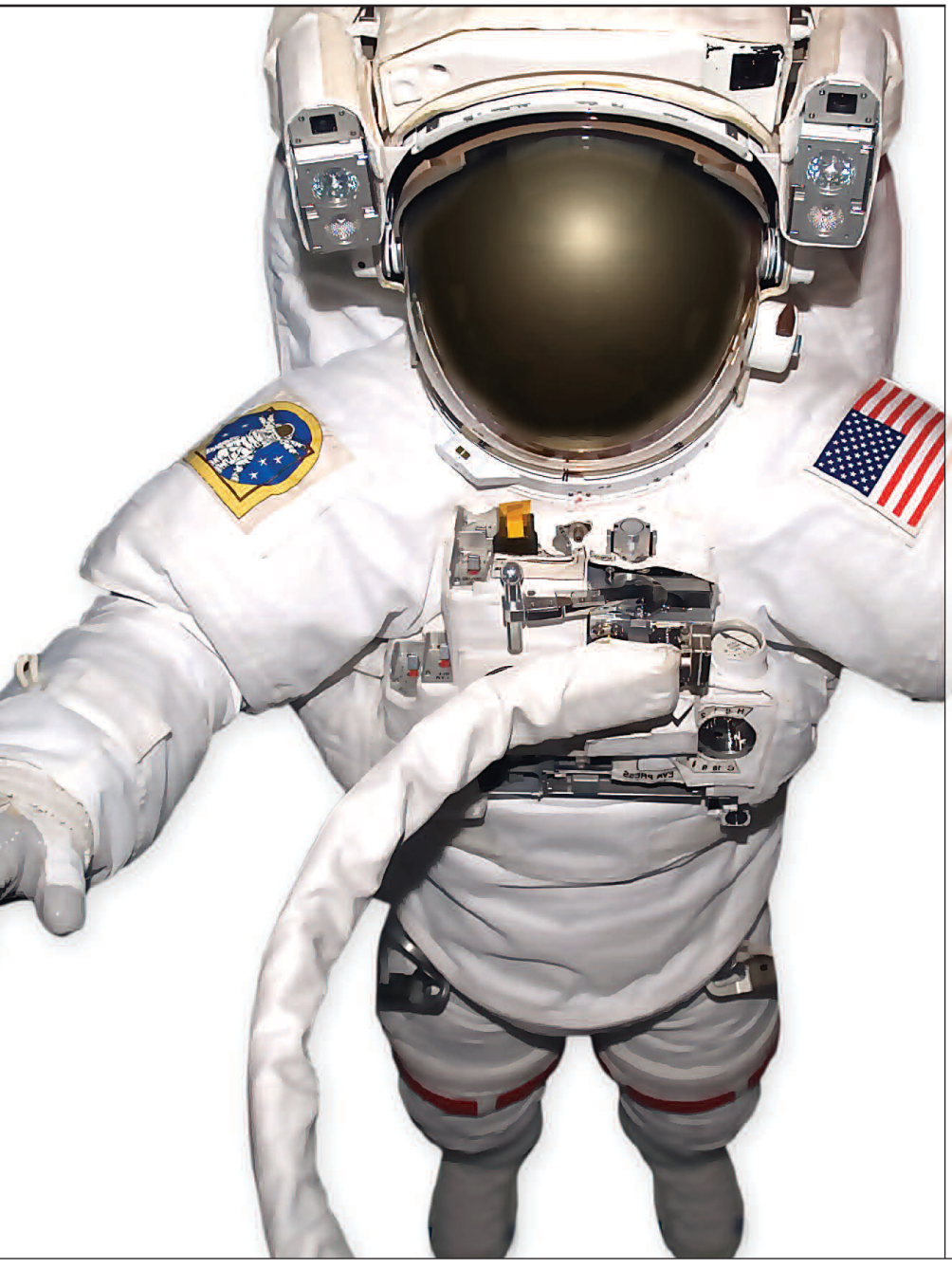
- Intellectual Property Management
- Technology Transfer
- New Innovative Partnerships



Summary of Partnering Tools

	Contract	Cooperative Agreement Grant	Space Act Agreement	Patent License	Enhanced Use Lease	CRADA
Purpose	Used by NASA to acquire goods, services, or both	NASA funding provided to facilitate activities that accomplish a public purpose	Used by NASA for collaborations with the public and private sector, including the performance of reimbursable work	Used by NASA to transfer specific rights associated with a NASA-owned invention	Permits NASA to lease underutilized real property assets	Rarely used by NASA for cooperative research and development
Competition Required?	Generally, Yes	Generally, Yes	In some circumstances	No	In some circumstances	No
Notable Requirement(s)	-Goods or Services -Mission Need	-Public Purpose -NASA may be involved	-Subject to statutory requirements and NASA requirements depending on type of collaboration	-Intellectual Property -Royalty-Based Commercialization	-Real Property	-Federal Lab -R&D
NASA Funding to the Non-NASA Party	Yes	Yes	Rarely	No	No	No
Process Owner	Office of Procurement	Office of Procurement	Space Act Agreements Manager	Technology Transfer Office	Center Real Property/Facilities Offices	Undefined at this time
Notable Advantage	$$$ to contractor	$ to awardee	Flexibility in structuring to meet needs	Exclusive Rights to an Invention	Improve usage of Real Property	Advanced Licensing of Inventions Not Yet Invented
Notable Disadvantage	Standard Regulations and Provisions	Standard Regulations and Provisions (but not nearly as large as the FAR)	Can be used only when activity is not covered by other statute or regulation	Royalty Payments as Consideration	No in-kind consideration	No Cash Contribution Allowed From NASA
Authority	Space Act; 31 USC 6303; 10 USC 2302	Space Act; 31 USC 6304; 31 USC 6305	Space Act	35 USC 207	Space Act; 42 USC 2459j	15 USC 3710a
Regulation	Federal Acquisition Regulations	Grant and Cooperative Agreement Handbook (14 CFR Part 1260)	NASA Policy and Space Act Agreement Guide	37 CFR Part 404, also referred to as the “Licensing Regulations”	Subject to NASA policy	No Formal Regulation

Combining Cancer Research and Nanotechnology to Ensure Astronaut Health



By Javed Khan and Romel D. Gomez

It is always satisfying to work in the challenging fields of cancer research and nanotechnology. But that satisfaction moves to a whole new level when coupled with the expectation that someday we will look up at the moon and know we played a part in keeping astronauts living up there healthy.

Hence the partnership between the National Cancer Institute (NCI); the University of Maryland, College Park (UMCP); and NASA's Goddard Space Flight Center, Greenbelt, Md., to develop an advanced nanobiosensor that enables fully electronic cancer mutation detection. Not only would this nanoscale field-effect transistor (nanoFET) replace the current and highly time-intensive fluorescence technique for DNA analysis, but it also will enable a miniaturized, simplified, low-power and potentially handheld diagnostic device that could be part of a medical toolkit in space exploration missions.

It is not surprising that cross-sector and multi-disciplinary efforts are needed in order to understand and develop nanotechnology-based tools for cancer research as well as diagnostic and

therapeutic applications for space applications. Such efforts require an in-depth understanding synthesis of single walled carbon nanotubes (SWCNTs), chip synthesis and associated electronics—which UMCP has. Also needed is significant cancer research infrastructure—which NCI has. And NASA of course has the understanding of the size, weight and low-power requirements of diagnostic tools used in monitoring the health of astronauts on long-duration, highly remote missions where they are exposed to potentially high radiation environments.

What is surprising is the fact that all of our respective capabilities can be brought together into a collaboration designed to achieve all of our individual research goals.

About the Collaborative Work

The memorandum of understanding between NCI, UMCP and NASA Goddard Space Flight Center sets forth the framework for our collaboration, which focuses primarily on the development of nanoFET platforms for nucleic acid hybridization detection. These platforms would incorporate sensor elements composed of silicon nano-wires and SWCNTs.

Working together, we will conduct the development-related activities associated with preparing prototypes that can test the nanoFET concept. Researchers at the three organizations will share data, characterization approaches and best practices. Such close collaboration will help in understanding and resolving the implications of nanoFET products for research and clinical-diagnostic applications as well as facilitate the development of a highly sensitive system for the electronic detection of nucleic acid hybridization. The collaboration also will help transfer the cancer science and engineering discovery and development ultimately to a comprehensive device whose output is the predicted diagnosis/prognosis/detection of cancer.

The collaboration also will help transfer the cancer science and engineering discovery and development ultimately to a comprehensive device whose output is the predicted diagnosis/prognosis/detection of cancer.

For astronauts as for patients here on Earth, these advances are expected to allow us to locate biomarkers in individuals' genetic makeup to predict a susceptibility to cancer. Specific to astronauts—who are susceptible to radioactive damage during long space-flight missions—the technology will enable their blood to be monitored over a long period of time.

Conclusion

As noted above, the partnership between NCI, UMCP and NASA brings together established experts in a surprising way. NASA's Innovative Partnerships Program makes such collaborations not just a possibility but a reality.

ABOUT THE AUTHORS

Javed Khan, M.D., is the chief of the Oncogenomics Section of the Pediatric Oncology Branch at NIH's National Cancer Institute. Romel D. Gomez, Ph.D., is a professor of Electrical and Computer Engineering at University of Maryland, College Park. ■

For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Goddard and LogicNets

Collaborate in the Building of a Test-bed Environment for an Intelligent Robotic System

A new agreement between NASA Goddard Space Flight Center, Greenbelt, Md., and LogicNets, Inc., is enabling collaborative development of an intelligence modeling and runtime environment for autonomous robotic systems. These intelligence models will be embedded into a variety of vehicles and will control the vehicles during various missions and tasks in different environments. The test-bed framework will also provide a means for testing new exploration technologies, procedures and techniques. Potential applications for intelligent autonomous vehicles are vast, including mapping, exploration and monitoring of land and water surfaces on Earth as well as unknown planetary surfaces.

Benefits of Technology Transfer

NASA will benefit by applying the robotic system to exploration of the Moon, Mars and Jupiter's moon Europa as well as potential exploration of other planetary surfaces.

NASA will be able to test any number of robotic vehicles using the new system without having to first invest the time and expense in hard coding

each potential vehicle.

In a modular and plug-and-play manner, NASA will be able to test new instruments, sensors, algorithms and procedures independent of the vehicle being used.

LogicNets will be able to apply the new, tested robotic system to other industries such as manufacturing as well as the automotive and airline industries, among others.

The general public may benefit from a new, flexible and economical technology that will enhance search-and-rescue operation missions as well as tracking and monitoring of dangerous environmental agents, homeland security operations and others.

About LogicNets

LogicNets has provided an easy-to-use, affordable online knowledge automation software platform since 1999. Based in Washington, D.C., the company serves customers in North America and Europe, providing the ability to distribute expertise to thousands of users as professional Web services.

Innovation Through Collaboration

Looking for new methods of exploration on the Moon, Mars and Europa (one of Jupiter's moons), Goddard scientists are researching many different autonomous robotic vehicles. Custom-making each vehicle, including hard coding procedures, would be very cumbersome, tedious and expensive. Researchers need a uniform, consistent, standardized framework in which to test the vehicles without committing time and funds to coding everything about the vehicles and their environment.

Working with LogicNets, NASA Goddard scientists will develop an artificial intelligence (AI) test-bed with the capability to predict if/how a vehicle will work in various exploration scenarios before time and funds are committed to vehicle development and mission deployment. Based on LogicNets' expert system application modeling and runtime environments, the system will also be able to control real vehicles and to make the decisions for the interaction between the robotic vehicle systems and the environment. Goddard will contribute software procedures and rules to develop the robotic test system, thereby populating the LogicNets framework with vehicle and environmental information and parameters for testing. The two organizations will also collaboratively test learning algorithms and develop a software framework independent of any specific type of vehicle.

The Transfer Process

LogicNets has been working for many years on its main product, which creates procedural models for the business world using an expert runtime environment. Goddard was looking for a company with expertise in this area and a product that could evolve into an autonomous system for robotic vehicles. Goddard was also seeking a company with motivation to invest its own resources in developing an AI testbed that would be applicable to NASA and had the flexibility for growth to accommodate new vehicles, vision systems, sensors, actuators and other technologies that NASA may deploy for future missions. LogicNets was one of few companies that fit the bill. Working diligently with Goddard's Innovative Partnerships Program (IPP) Office, Goddard scientists and LogicNets arrived at an agreement that is mutually beneficial. The work performed under the nonreimbursable Space Act Agreement signed in March 2007 will answer NASA's need for a robotic vehicle test system while increasing LogicNets' competitive advantage and potential market penetration.

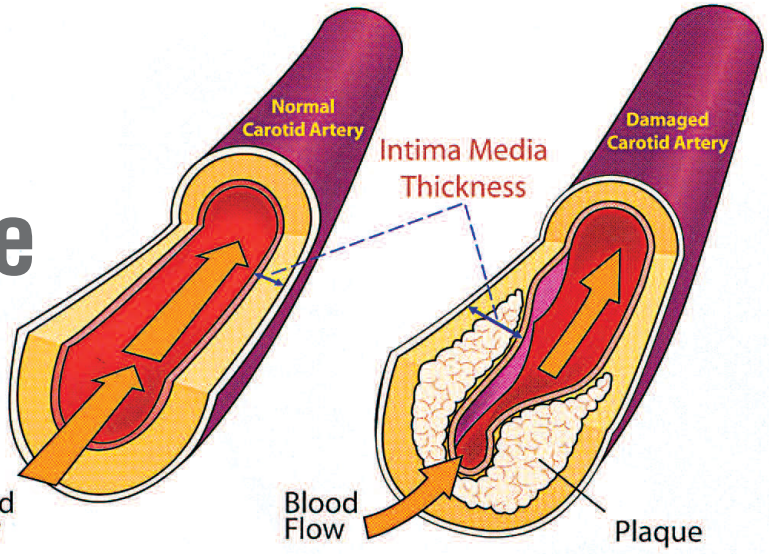
Looking Ahead

With an agreement in place, researchers at both organizations are collaborating to develop a robotic system that can be defined and tested in any exploration scenario. They expect the work to take at least two years to complete, at which time testing and evaluation may be followed by implementation in NASA exploration missions. ■

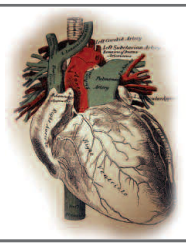
For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

NASA Technology Helps Detect and Treat Heart Disease and Strokes



GRAPHIC CREDIT: NASA



NASA space technology is helping doctors diagnose and monitor treatments for hardening of the arteries in its early stages, before it causes heart attacks and strokes.

Hospitals and doctors around the country are using ArterioVision software initially developed at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., along with a standardized, painless, non-invasive ultrasound examination of the carotid artery, which carries blood from the heart to the brain.

A standard carotid ultrasound measures plaque and blood flow within the artery. When an ultrasound is used with the software, the test measures the thickness of the inner two layers of the carotid artery – the intima and media. Medical Technologies International Inc. (MTI) of Palm Desert, Calif., patented the ArterioVision software.

Arterial thickening provides the earliest evidence of atherosclerosis, or hardening of the arteries, the beginning stage of a disease process that leads to heart disease and stroke. Doctors can use this carotid intima media thickness (CIMT) measurement to calculate the age of the patient's arteries, which does not always match the patient's calendar age.

"You may look and feel one way on the outside, but your arteries actually could be much older than one realizes," said Dr. Howard N. Hodis of the Keck School of Medicine at the University of Southern California, Los Angeles. "Once patients see how thick their arteries are, there is much more incentive for them to change their lifestyle with dietary modification and exercise. Physicians also can use the test to monitor and change current medications."

The U.S. Food and Drug Administration has approved the new diagnostic tool, called the ArterioVision CIMT procedure. Robert Selzer, MTI chief engineer, worked in JPL's Image Processing Laboratory for 15 years, where the technology was developed that ultimately led to the software used in ArterioVision.

"This is such a precise method of examining the carotid artery. It can distinguish between 256 shades of gray at a subpixel level," Selzer said. "You need that kind of detail to help catch heart disease as early as you can, often before there are any out-

PHOTO CREDIT: NASA/JPL

CAROTID ARTERY ULTRASOUND, USED WITH NASA SOFTWARE, DETECTS THICKNESS OF THE ARTERIES.

ward symptoms."

During the test, a patient lies on an examination table while a technician applies gel to the neck to image the carotid arteries, located on both sides of the neck near the skin's surface. The technician uses an ultrasound machine while following a patented protocol to capture specific images of the carotid artery wall. Using the ArterioVision software, the physician generates a CIMT measurement and a report that identifies the patient's risk profile when compared to people of the same gender and age.

JPL's Image Processing Laboratory was created in 1966 to receive and make sense of spacecraft imagery. In the lab, the NASA-invented Video Imaging Communication and Retrieval software has been used to process pictures from numerous space missions, including the Voyagers and Mars Reconnaissance Orbiter. Periodic upgrades of the imaging software have enabled greater accuracy and improved knowledge of our solar system, and have laid the groundwork for understanding images of all kinds.

The ArterioVision test was developed with JPL's Innovative Partnerships Program, designed to bring benefits of the space program to the public. "It is exciting to see this NASA-funded technology grow in sophistication over the years and help in the battle against one of the nation's leading health issues," said Ken Wolfenbarger, Innovative Partnerships Program manager at JPL. The American Heart Association says heart disease is the leading cause of death in the United States, while strokes are third, behind all forms of cancer.

Gary F. Thompson, chairman and chief executive officer of MTI, says the test is near and dear to his heart – literally and figuratively. "I was the first male in my family to reach 50, so I decided to celebrate by running the Los Angeles marathon, but I had a heart attack halfway through it and couldn't finish," Thompson said. "None of the non-invasive tests that I had prior to the marathon detected my silent heart disease, and I knew there had to be something better out there." ■

For more information, visit http://www.i-mti.com

Please mention that you read about it in Technology Innovation.

Merging Two POWERFUL SOFTWARE TOOLS to Create a One-of-a-Kind Exploration Capability

Under a partnership made possible by IPP's Seed Fund program, Goddard Space Flight Center, Greenbelt, Md., is integrating the ILIADS software, a geospatial information system (GIS) developed for lunar applications, with Questus™, a management and planning software tool developed by United Space Alliance (USA) for Space Shuttle operations. The integration will result in a new decision-making application that NASA can use to plan and carry out future robotic and crewed missions to the Moon.

Benefits of Technology Transfer

The resulting ILIADS-Questus software product will allow mission planners to directly apply scientific data gathered from remote-sensing satellites and other sources to select potential landing and habitat sites.

- Ultimately, the tool will support human exploratory sorties on the lunar surface later in the next decade.
- USA can commercialize the new product, particularly in its work developing NASA's next-generation transportation system, the Crew Exploration Vehicle (CEV).
- As private companies increase their participation in lunar exploration, they too will need access to scientific data and decision-making tools afforded by ILIADS, its facilities and the system's associated scientific expertise. The integrated software will meet those needs, providing an additional revenue stream for the company.

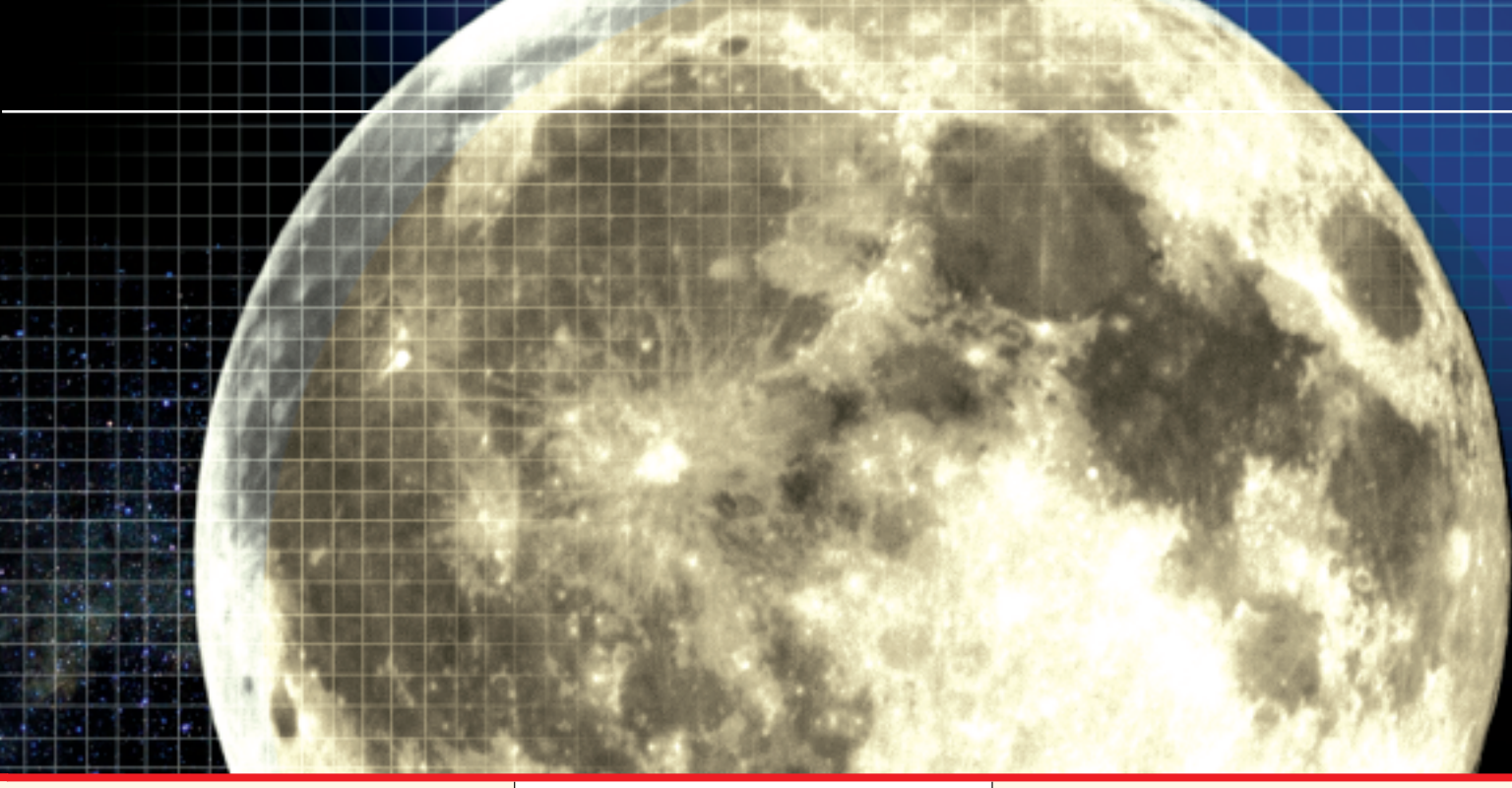
About United Space Alliance

United Space Alliance is a world leader in space operations, with extensive experience in virtually all aspects of the field. Headquartered in Houston and employing 10,000 people in Texas, Florida and Alabama, USA is applying its broad range of capabilities to NASA's Space Shuttle, International Space Station and Constellation programs as well as to space operations customers in the commercial and international space industry sectors.

Technology Origins

Using internal research and development funding, Goddard technologists modified commercial off-the-shelf GIS software typically used in terrestrial applications to design an integrated tool suite useful for lunar exploration. ILIADS—short for Integrated Lunar Information Architecture for Decision Support—gives users access to three-dimensional lunar crater scenes, topographic contour maps, surface distance and elevation measurements, in situ resource and hazard maps, as well as historical mission data and other useful datasets.

USA also used its own internal resources to develop Questus, which combines three software programs



that the company developed for space operations. The toolkit offers a variety of functions that will help mission-operations personnel more efficiently find and retrieve information, schedule daily astronaut activities, and carry out robotic operations. Questus was scheduled for beta testing following the International Space Station Expedition 15 mission in March 2007. The full-up program—Questus 1.0—was made available for CEV systems in July 2008.

Finding a New Use

NASA planners and decision makers must be able to process, analyze, display and manipulate all types of environmental information about the Moon to ensure the success of the Agency's lunar exploration program. Such an all-in-one decision-making and planning tool currently does not exist. Goddard is modifying ILIADS so that its server, server interface and datasets are available to Questus in a standard format. Meanwhile, USA is modifying Questus to support ILIADS's lunar environmental data. With these modifications, including a continuous zoom-and-pan function, users will be able to visually specify geographic areas on the Moon and quickly retrieve more specific data about that area.

The Transfer Process

Goddard and USA developed their software tools independently. From consultations with Goddard's Innovative Partnerships Program Office, both realized that their tools could become more powerful and have wider application if they were integrated. In 2006, NASA selected the collaboration for its Partnership Seed Fund and provided additional resources for the partners to integrate these two software systems under their respective internal R&D investment programs. The Partnership Seed Fund, which NASA introduced in 2006, is designed to encourage joint-development partnerships between its organizations, private industry and others.

Looking Ahead

Goddard and USA expect to complete the integration of ILIADS and Questus in time for the Lunar Reconnaissance Orbiter (LRO), a Goddard-led mission that will spend a year mapping the Moon after its launch in 2008. With the new capability, exploration mission planners will get faster, more efficient access to LRO data, which they can then use to plan and carry out subsequent missions to the Moon, including crewed lunar operations. ■

For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

Low-Cost, Accurate Monitor of RF-Induced Currents

NASA Goddard Space Flight Center invites companies to license this patented, wearable device that provides a superior means for monitoring radio frequency (RF)-induced currents in the body. The device consists of a probe with a nonferrous core, making it lightweight, flexible and more accurate than ferrous-core devices. The probe is coupled with a specialized transimpedance amplifier circuit that allows for use over an extremely wide range—between 60 Hz and 110 MHz—accurately and without the need for recalibration. This technology provides the first low-cost, accurate means of directly measuring RF-induced currents in the body, thereby ensuring that individuals exposed to RF radiation remain within the safety standards. A specific absorption rate (SAR) may then be calculated using known dielectric properties of the human body.

Benefits

This technology provides the first-ever practical means for directly measuring RF-induced currents, ensuring that individuals remain within the basic limits stipulated by international organizations:

- **Increased accuracy:** The device provides an accurate, high-resolution direct RF-current measurement over a broad frequency range. This eliminates the need for calibration for differing frequencies and the measurement errors that are induced when multiple frequencies are present.
- **Versatile:** The device provides constant sensitivity over a large usable bandwidth, and its design can be modified to allow product flexibility.
- **Lightweight:** Because the core of this device is nonferrous, it is significantly lighter than ferrous-core clamps and does not change the impedance of the object being measured.
- **Minimal product development cost:** A working prototype exists that has demonstrated a flat response over a frequency range of 300 kHz to 110 MHz.
- **Low cost:** The parts required to manufacture this device are inexpensive.

Applications

This device is ideal for any situation involving exposure to RF radiation:

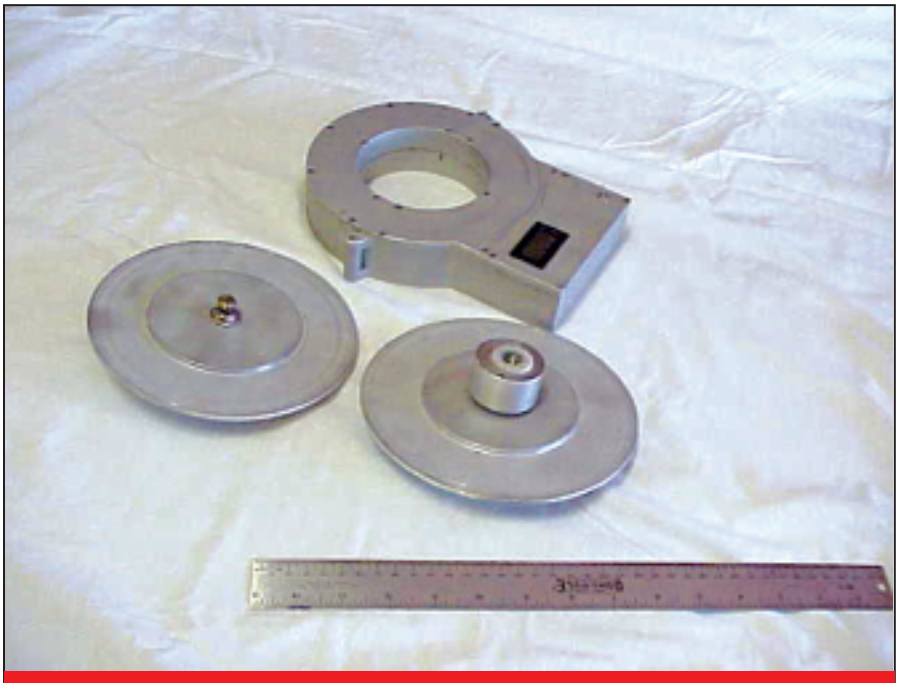
- **Plastics manufacturing:** The device can help ensure worker safety for operators of RF heat sealers, welders, ovens and other equipment used in manufacturing a wide range of plastics and composite materials.
- **Broadcasting:** Personnel servicing AM and FM radio, VHF TV channels, and other specialized transmitters that are not shut off during maintenance can use this device.
- **Military:** Personnel in close proximity to powerful transmitters on ships or airplanes would benefit from this technology.
- **Antenna design:** Developers and testers of antenna designs can make measurements more easily using this technology.
- **Cancer treatment:** Individuals receiving RF-based hyperthermia treatments could use this technology to ensure that heating is not occurring in other parts of the body.

Technology Details

This technology includes a nonferrous current probe based on a conductive toroidal coil. When placed around the leg or other body member, the probe acts as a transformer. As RF-induced current in the body generates a magnetic field, the probe's magnetic pickup (Rogowsky) coil responds. The voltage induced on the coil is directly proportional to the time derivative of the magnet flux through the coil.

The coil is integrated with a wideband transimpedance amplifier circuit with a design that keeps the sensitivity of the current probe substantially flat over a wide frequency range—60 Hz to 110 MHz. This frequency range makes the device useful with AM and FM

Photo credit: NASA/GSFC



Current probe shown with calibration cell

transmitters as well as with RF heating equipment such as sealers, ovens and welders (27.12 MHz).

This technology's innovative design offers several advantages. Because it does not affect the impedance of the body, does not introduce an additional antenna and has a flat response over a broad frequency range, this device provides a more accurate measurement. This accurate measurement of RF-induced current in the body is particularly useful in applications where various frequencies may be present (e.g., harmonics)—a capability not presently available in similar products. Its nonferrous core is inexpensive, lightweight and provides for flexibility in product design, allowing the development of devices that can be worn comfortably around the ankle, leg, arm, wrist, chest, neck, etc.

Beyond its design advantages, this device directly measures RF-induced currents in the human body, making practical a direct calculation of specific absorption rate. IEEE safety standards for human exposure to RF (adopted by most regulatory bodies as the basis for legal statutes) specify SAR as the basic metric of safety (IEEE Std. C95.1-1991). Because measuring induced currents, more directly associated with SAR, was previously costly, inaccurate or impractical, the standards set forth maximum permissible exposure (MPE) limits in terms of electromagnetic field (EMF) strengths. However, the standard itself noted that "absorption of electromagnetic energy from even the most uniform field can result in highly variable anatomical depositions of energy." Because of this uncertainty—due to such variables as height, weight, body shape and changing body position—the EMF safety limits are overstated by as much as a factor of 100. Moreover, in cases where RF shock or burn may be possible, the IEEE standard still states that:

Induced body currents should be measured by determining the RF current flowing to ground through the feet of the individual. Contact currents should be measured by determining the RF current through the hand in contact with the ungrounded surface.

Because this device can directly measure the actual EMF-induced current flowing at any point in the human body, both these induced and contact currents can be directly measured, as well as a SAR being calculated. As a result, this device provides a low-cost means for companies with workers exposed to RF radiation to confirm unequivocally that employees are safe. ■

For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

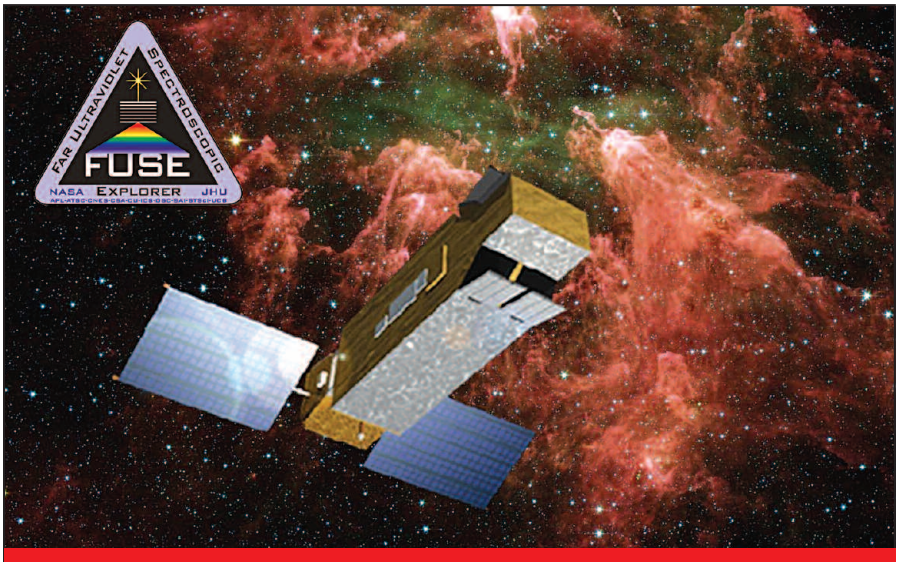
Please mention that you read about it in Technology Innovation.

designAmerica and Commercial ASIST – an important and continuing tech transfer success story

By Thomas J. Green
President, designAmerica

Editor's note: *During the 1990s, designAmerica participated in the development of the Advanced System for Integration and Spacecraft Test (ASIST) technology. ASIST is a real-time command and control system for spacecraft development, integration, and operations. designAmerica licensed ASIST from NASA Goddard Space Flight Center, Greenbelt, Md., in October 2003, making it available as a commercial off-the-shelf (COTS) product. The result is benefits to NASA's Exploration Systems and Science Mission Directorates as well as growth for the company.*

GRAPHIC CREDIT: JHU FUSE PROJECT



HAVING SUCCESSFULLY SUPPORTED SUCH MISSIONS AS THE FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER (FUSE) AND THE EARTH OBSERVER-1 SATELLITE, ASIST IS ALSO EXPECTED TO BENEFIT FUTURE MISSIONS, SUCH AS THE PROPOSED MAVEN MISSION TO STUDY THE EVOLUTION OF THE ATMOSPHERE AND VOLATILES ON MARS.

As one of the original developers of ASIST for the X-Ray Timing Explorer in the 1990s, the Annapolis, Maryland–based company designAmerica knew early on that it had a very important software application that could have a big impact within the broader aerospace community. This was because ASIST was designed from the ground up to be both fully functional across a broad spectrum of satellites and instrumentation while being easy to use with the end-user always in mind. ASIST is both a highly complex computer application meeting the technical requirements of today's rapidly evolving satellites and instruments and a highly effective tool for the engineers that build and operate that technology. Rich and deep functionality plus a good user interface are the keys to ASIST's success—because they were designed in that way from the beginning.

With many successful missions under its belt, ASIST is indeed the ground system of choice for the successful satellite or instrument project. Building on the dedication and hard work by the designAmerica team and the foresight and support of the Innovative Partnerships Program Office at NASA Goddard Space Flight Center through its licensing program, ASIST is well on its way to becoming the commercial success that was originally envisioned in those early days.

Once in the domain of special (and

expensive) custom-developed software on a per-project basis, the ASIST state-of-the-art ground system technology has moved into the COTS world to spread this important technology to the benefit of all.

As an example of commercialization success, Northrop Grumman has chosen designAmerica and ASIST to be its basic rapid development component for its in-house project flight software development and avionics integration and test labs. This work benefits a range of satellites that the company is developing in-house, including NASA missions such as the Lunar Crater Observation and Sensing Satellite (LCROSS). With ASIST at the core of its development suite, Northrop Grumman has demonstrated impressive gains in automated development and testing. In this way, the company has streamlined satellite development and saved substantial mission dollars. This is a real commercial ASIST success story resulting in faster, better and cheaper development at Northrop Grumman which directly translates into more (and better) science.

Similarly, designAmerica and ASIST were recently selected by Lockheed Martin to be the in-house integration and test (I&T) and mission operations system at its satellite production facility in Denver for two important future NASA missions: the Mars Atmosphere and Volatile Evolution (MAVEN) and the RQ36 asteroid-rendezvous mission OSIRIS. In fact, the demonstrated cost savings for the ground system element alone by using ASIST over the competition for OSIRIS was well over $3 million.

With many successful missions under its belt, ASIST is indeed the ground system of choice for the successful satellite or instrument project.

What was once many years ago just an idea has proven to be a significant commercialization success story, benefiting business and industry and, most importantly, the basic science mission. In this significant way, ASIST is a true commercialization success story.

And what is most surprising is the new product ideas that come back to designAmerica and ASIST from the interaction with the new commercial customer base (and the new perspectives) in the broader aerospace community. Engineers always have unique ways of looking at new problems, and by spreading commercial ASIST to new satellites and diverse missions, we continue to grow and enrich the basic ASIST product with the many new ideas encountered. A key to our innovation really is to incorporate the new ideas and required new functionality into the basic product. In this way, the quality and breadth of the product evolve to meet future mission requirements. It is a nice new-development cycle.

One important lesson learned for us in the technology transfer of a complex software product such as ASIST is the importance of patience. Results do not come overnight, and the commercial aerospace market is fairly narrow yet highly competitive. This makes it tough to build a company based on product sales. As a small company with very little capitalization, designAmerica simply does not have the marketing budget or sales force that our bigger competitors have (some of them Fortune 500 companies). So for us, a key has been to simply recognize this fact and therefore focus on being both different and better to separate ourselves from the pack. We accomplish this by a singular focus on the product itself and its quality. Based on this quality emphasis and better future marketing, sales growth is expected to follow. ■

For further information on ASIST, please contact the author or visit designAmerica's Web site (www.dai-asist.com).

Please mention that you read about it in Technology Innovation.

Innovative Research

Paragon Space Development Corporation Honored with Tibbetts Award

An Arizona-based company that specializes in aerospace engineering and technology development has been selected as one of the winners of a Tibbetts Award.

Named for Roland Tibbetts—the person acknowledged as the father of the Small Business Innovation Research (SBIR) program—these prestigious national awards are made annually to those small firms, projects, organizations and individuals judged to exemplify the best in SBIR achievement. Paragon Space Development Corporation is one of 55 U.S. companies to receive this award.

The organization was selected from more than 4,000 companies to receive contracts and grants under the SBIR Program. SBIR provides Paragon with a unique vehicle for innovative technology, positioning the company as a key provider of environmental control and life support systems.

SBIR enables Paragon to significantly contribute to otherwise cost-prohibitive endeavors such as those pursued by NASA. SBIR provides Paragon with funding not generally available in small business budgets to research, develop and test the Navy contaminated water diving system, spacecraft hardware, an expensive and complex enterprise. SBIR also provides the opportunities to coordinate with NASA to ensure the research is meaningful, guaranteeing a more commercially attractive product. Finally, SBIR supports internal R&D resources, enabling Paragon's dedication to advanced technology development. Given the cost and time commitments required for spacecraft hardware development, SBIR support has been, and remains, critical to the success of Paragon's pioneering technology development and commercialization.

The combination of funding, customer coordination by the Contracting Officer's Technical Representative, and relationship building makes SBIR valuable. Through SBIR, Paragon was able to create a fully tested integral radiator design, demonstrate its skill set in radiator technology development while gaining visibility within the aerospace industry. This also strengthened its relationship with NASA. Paragon's significant role of providing mission critical subsystems, such as the heat rejecting radiators for the Orion Spacecraft, the Space Shuttle replacement (the vehicle that will carry American astronauts back to the Moon and on to Mars) is the Phase III SBIR. SBIR support has allowed Paragon to become a leader in spacecraft radiator technology development, a difficult task considering the financial constraints and limited opportunities within a small commercial sector.

Paragon also is a subcontractor to Oceaneering International Inc., which recently won a contract with NASA to design, develop and produce a new spacesuit system. The system will protect astronauts during Constellation Program voyages to the International Space Station and the Moon.

Paragon Space Development Corporation is a woman-owned small business and full-service aerospace engineering and technology development firm. The company is a major supplier of Environmental Control and Life Support System (ECLSS) and subsystem design for the aerospace industry. Paragon also is expert in thermal control, both for spacecraft on orbit and during re-entry, and hyper-velocity aircraft. The company is a leader in the integration of systems engineering with human factors, risk management and business processes for high technology endeavors in water, on land and in space. ■

For more information, visit http://www.paragonsdc.com.

Please mention that you read about it in Technology Innovation.

EXAMPLES OF HOW NASA IS WORKING WITH SMALL BUSINESSES AND ACADEMIA

STTR Company with Exploration-Related Technology Acquired by Microsoft

Vexcel Corp., a recipient of Small Business Technology Transfer (STTR) Program funding from NASA Goddard Space Flight Center, Greenbelt, Md., has been acquired by Microsoft Corporation as part of its Virtual Earth™ business unit. Vexcel's many technologies, including a wireless sensor network technology developed under the STTR funding, will help the computing giant produce rich, dynamic sets of imagery and data that will be integrated into the new Live™ Search: Maps service, which is driven by the Virtual Earth geospatial data platform. Microsoft recognized the value of Vexcel's 20-year history in imagery, photogrammetry and remote sensing technology and particularly its pool of talented and experienced employees. The wireless sensor network technology will aid in the high-speed handling of data that is critical to the project's success. Additionally, the new technology will have significant impact in many areas of Earth sciences field research.

Benefits of Technology Transfer

Scientists and researchers will be able to acquire and analyze data remotely using the STTR-funded wireless sensor network technology.

The technology will contribute real-time information to Microsoft's Live Search geographic search engine with many "information telepresence" applications. For example, firefighters could rapidly locate and track the spread of forest fires, and air traffic control could divert trans-Pacific flights away from ash plumes emanating from erupting Aleutian volcanoes.

The technology's broad applications can contribute significantly toward NASA's efforts in both Earth sciences and interplanetary exploration.

About Vexcel Corporation

A worldwide leader in photogrammetry, imagery and remote sensing technologies, Vexcel was founded in 1985 with headquarters in Boulder, Colo., and offices in Austria, Canada, the Netherlands and the United Kingdom. Vexcel brings to Microsoft extensive experience in two-dimensional and three-dimensional imagery that will enable rich sets of aerial and street-side imagery to be delivered in a much easier and timely fashion. Vexcel's people and technology will also play a central role in enabling Microsoft's Virtual Earth platform to support dynamic contributions of information from consumers, businesses, governments and others to strengthen the overall platform and its applications in the future.

Technology Origins

This technology takes NASA a step closer toward fulfilling needs for real-time recovery of remote sensor data. The wireless sensor network nodes or microservers that Vexcel developed under the STTR contracts work similarly to a wireless office network, relaying information between devices. However, instead of linking computers down the hall, the interconnected microservers can be many kilometers from one another. These devices were originally designed for seismology on remote glaciers and ice streams in Alaska, Greenland and Antarctica, acquiring, storing and relaying data wirelessly between ground sensors. This technology enables three deployment concepts. First, a researcher in the field can establish a "managed network" of microservers and rapidly see the data streams (recovered wirelessly) on a field computer. This rapid feedback would permit the researcher to reconfigure the network for different purposes over the course of a field campaign. Second, through careful power management the

INNOVATIVE RESEARCH

PHOTO CREDIT: GSFC

A screenshot from Microsoft's new Live™ Search: Maps* service. Vexcel, a recipient of STTR funding, developed a wireless sensor network technology that will help the computing giant produce rich, dynamic sets of imagery and data that will be integrated into Live Search.

microservers can dwell unsupervised in the field for up to two years, collecting tremendous amounts of data at a research location. The third concept is the exciting potential to deploy a microserver network that works in synchrony with robotic explorers (e.g., providing ground truth validation for satellites, supporting rovers as they traverse the local environment). Managed networks of remote "microservers" that relay data unsupervised for up to two years can drastically reduce the costs of field instrumentation and data recovery.

Finding a New Use

While they were originally developed to relay data from remote locations for NASA's Earth sciences research, these microservers will help enable Microsoft's Virtual Earth project to bring real-time imagery and other types of searchable data to the fingertips of Internet users everywhere. Microsoft needed the ability to gather real-time geospatial data (i.e., information connected to specific geographical locations) in order to provide users not only text data and maps from searches but also imagery including a bird's-eye view and three-dimensional pictures. Vexcel's Dr. Robert Fatland says, "The Virtual Earth geospatial data platform is moving towards a vision expressed as 'browsing the physical Earth,' enabling people to better understand their environments."

The Transfer Process

STTR is a highly competitive three-phase program that reserves a specific percentage of federal R&D funding for award to small businesses in partnership with nonprofit research institutions to move ideas from the laboratory to the marketplace, to foster high-tech economic development, and to address the technological needs of the federal government. Vexcel had partnered with Pennsylvania State University to develop the microserver technology under STTR Program awards from NASA Goddard Space Flight Center in 2002 (Phase 1) and 2004 (Phase 2). A commercial version was then developed during Phase 3.

EXAMPLES OF HOW NASA IS WORKING WITH SMALL BUSINESSES AND ACADEMIA

Looking Ahead

Beyond the original STTR-funded research and the Virtual Earth platform, the technology has much broader goals. As Dr. Fatland explains, "Data from the field has historically been hard won, but two revolutions during the past half century have shattered the coarse granularity of painstaking observation. First, remote sensing has broken the spatial sampling density barrier. And now wireless sensor networks give us ground truth at any desired sampling frequency in near real time. Commensurate with these technologies, the climate change crisis has arrived with a host of other needs for 'more and better' data delivered rapidly. The objective in working on smart sensor networks is to provide multiple real-time environmental information streams for a variety of uses but primarily geoscience research and education. Other important applications include health monitoring, disaster mitigation, civil infrastructure support and many more. In fact, sensor networks are important because they are applicable to any situation where we benefit from extension of our senses into a larger environment."

In addition to further internal R&D supported by Microsoft, the technology continues to be developed by Vexcel researchers under funding from NASA's Earth Science Technology Office's Advanced Information Systems Technology program. Working under the acronym SEAMONSTER (South East Alaska Monitoring Network for Science, Telecommunications, Education, and Research), the project supports collaborative environmental science with near-real-time recovery of large volumes of environmental data. The initial geographic focus is at Alaska's Lemon Glacier and Lemon Creek watershed near Juneau where the technology is being used to relay data about the glacier's effect on the hydrochemistry of Lemon Creek. Future expansion is planned in the Juneau Icefield and the coastal marine environment of the Alexander Archipelago.

This innovative sensor network technology may play a significant role in global climate research as well as many other Earth science–related monitoring projects. In addition to these applications, Vexcel researchers are designing SEAMONSTER to be a powerful learning and teaching tool both through its construction and in planning for its future operation.

Lessons learned

Dr. Fatland's suggestions regarding lessons learned are related to typical enthusiasm that develops for the project as it proceeds. In short, temper enthusiasm with a healthy dose of conservatism, and document as you go. He encourages the use of a wiki or other online collaboration tools to document progress.

"Although it is tempting to 'focus on the work,' the fun part, it is important and beneficial to give serious attention to administrating project cost and reporting," Fatland said. "Treat the field testing aspect of a new technology as hermetic to your research group. In particular, given the opportunity to collaborate with external investigators, work in parallel rather than in an integral mode until the technology is mature and demonstrated as reliable." ■

For more information, contact GSFC's Innovative Partnerships Program Office, (301) 286-2642, techtransfer@gsfc.nasa.gov.

Please mention that you read about it in Technology Innovation.

NASA'S IPP NETWORK

visit www.ipp.nasa.gov

NASA CENTERS:

- ARC – Ames Research Center
- DFRC – Dryden Flight Research Center
- GRC – Glenn Research Center
- GSFC – Goddard Space Flight Center
- HQ – Headquarters
- JPL – Jet Propulsion Laboratory
- JSC – Johnson Space Center
- KSC – Kennedy Space Center
- LaRC – Langley Research Center
- MSFC – Marshall Space Flight Center
- SSC – Stennis Space Center

ALLIED ORGANIZATIONS:

- CAFE – Comparative Aircraft Flight Efficiency Foundation
- CASI – NASA Center for AeroSpace Information
- CSEWI – California Space Education & Workforce Institute
- FLC – Federal Laboratory Consortium
- NTTC – National Technology Transfer Center
- SF – Space Foundation
- SWF – The Spaceward Foundation
- VAS – Volanz Aerospace, Inc./Spaceflight America
- XPF – XPRIZE Foundation

★ NASA Headquarters

Innovative Partnerships Program Offices at each of NASA's 10 Field Centers represent NASA's technology sources and manage center participation in technology transfer activities.

■ Allied Organizations support NASA's IPP objectives.

★ Centennial Challenges Allied Organizations

National Aeronautics and Space Administration
Innovative Partnerships Program Network

NASA Headquarters

300 E Street, SW
Washington, DC 20546

Douglas A. Comstock
Director, Innovative Partnerships Program
Phone: 202/358-2221
E-mail: doug.comstock@nasa.gov

Carl G. Ray
Program Executive, Technology Infusion, Innovative Partnerships Program Office
Phone: 202/358-4652
E-mail: carl.g.ray@nasa.gov

Janelle Turner
Program Executive, Outreach, Innovative Partnerships Program Office
Phone: 202/358-0704
E-mail: janelle.b.turner@nasa.gov

NASA Field Centers

Ames Research Center
Moffett Field, California 94035

Aviation Safety, Airspace Systems, Avionics and Software, Protection Systems, Space Radiation, Small Spacecraft, Information Technologies, Integrated Health System Management

Lisa Lockyer
Chief, Technology Partnerships Division
650/604-1754
lisa.l.lockyer@nasa.gov

Dryden Flight Research Center
4800 Lilly Drive, Building 4839
Edwards, California 93523-0273

Aviation Safety, Atmospheric Research

Gregory Poteat
Chief, Technology Transfer Partnerships Office
661/276-3872
gregory.a.poteat@nasa.gov

Glenn Research Center
21000 Brookpark Road
Cleveland, Ohio 44135

Aviation Safety, Fundamental Aeronautics, Aeronautics Test Technologies, Environmental Control and Life Support, Extra Vehicular Activity, Lunar Operations, Energy Generation and Storage, Protection Systems, Exploration Crew Health Capabilities, Spacecraft and Platform Subsystems, Space Communications and Navigation, Processing and Operations

Kathleen Needham
Director, Technology Transfer and Partnership Office
216/433-2802
Kathleen.K.Needham@nasa.gov

Goddard Space Flight Center
Greenbelt, Maryland 20771

Structures, Materials, Mechanisms, Sensors, Detectors, Instruments, Advanced Telescope Systems, Spacecraft and Platform Subsystems, Information Technologies, Space Communications and Navigation

Nona Cheeks
Chief, Office of Technology Transfer
301/286-5810
nona.k.cheeks@nasa.gov

Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, California 91109

Environmental Control and Life Support, Sensors, Detectors, Instruments, Advanced Telescope Systems, Robotics, Space Communications and Navigation

Andrew Gray
Manager, Commercial Program Office
818/354-4906
gray@jpl.nasa.gov

Johnson Space Center
Houston, Texas 77058

Sensors for Autonomous Systems, Environmental Control and Life Support, Extra Vehicular Activity, Lunar In Situ Resource Utilization, Lunar Operations, Thermal Management, Exploration Crew Health Capabilities, Space Human Factors and Food Systems, Space Radiation

Michele Brekke
Director, Technology Transfer Office
281/483-4614
michele.brekke@nasa.gov

Kennedy Space Center
Kennedy Space Center, Florida 32899

Space Transportation, Processing and Operations, Launch Site Technologies

David R. Makufka
Chief, Innovative Partnerships Program Office
321/867-6227
david.r.makufka@nasa.gov

Langley Research Center
Hampton, Virginia 23681-2199

Aviation Safety, Fundamental Aeronautics, Airspace Systems, Avionics and Software, Structures, Materials, Mechanisms, Sensors, Detectors, Instruments, Atmospheric Research

Brian Beaton
IPP Manager, Advanced Planning & Partnerships Office
757/864-2192
brian.f.beaton@nasa.gov

Marshall Space Flight Center
Marshall Space Flight Center,
Alabama 35812

Structures, Materials, Mechanisms, Propulsion and Cryogenic Systems, Advanced Telescope Systems, Space Transportation

James Dowdy
Director, Technology Transfer Office
256/544-7604
jim.dowdy@nasa.gov

Stennis Space Center
Stennis Space Center, Mississippi 39529

Space Transportation, Rocket Propulsion Testing

Ramona Pelletier Travis
Manager, Innovative Partnerships Program Office
228/688-3832
ramona.e.travis@ssc.nasa.gov

Allied Organizations

National Technology Transfer Center (NTTC)
Wheeling Jesuit University
316 Washington Ave.
Wheeling, West Virginia 26003

Darwin Molnar
Vice President
800/678-6882
dmolnar@nttc.edu

United States Space Foundation
310 S. 14th Street
Colorado Springs, Colorado 80904

Kevin Cook
Director, Space Technology Awareness
719/576-8000
kevin@spacefoundation.org

Federal Laboratory Consortium
300 E Street, SW
Washington, DC 20546

John Emond
Collaboration Program Manager
202/358-1686
john.l.emond@nasa.gov

NASA Center for AeroSpace Information
Spinoff Project Office
7115 Standard Drive
Hanover, Maryland 21076-1320

Daniel Lockney
Editor/Writer
301/621-0224
dlockney@sti.nasa.gov

Tech Briefs Media Group
1466 Broadway, Suite 910
New York, NY 10036

Joe Pramberger
Publisher
212/490-3999
joe@techbriefs.com

Centennial Challenges

The X PRIZE Foundation
Santa Monica, CA
http://space.xprize.org/

Volanz Aerospace, Inc./ Spaceflight America
Owings Mills, MD
http://www.spaceflightamerica.org

The Spaceward Foundation
Mountain View, CA
http://www.spaceward.org/

California Space Education & Workforce Institute
Pasadena, CA
http://regolith.csewi.org/

Comparative Aircraft Flight Efficiency Foundation
Santa Rosa, CA
http://cafefoundation.org/

FIRST CLASS MAIL
POSTAGE & FEES PAID
NASA
PERMIT NO. G27

National Aeronautics and Space Administration

Innovative Partnerships Program
Washington, DC 20546-001

www.nasa.gov

NP-2008-06-526-HQ