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Aerospace Technology

INNOVATION

Extending NASA's Technological Reach

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Online Edition: Go to **http://nctn.hq.nasa.gov** on the World Wide Web for current and past issues.

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COMMERCIAL DEVELOPMENT MISSION UPDATE

Date*	Flight	Payload	Sponsor/Coordinator
4/00	STS-101	ASTROCULTURE™ Commercial Protein Crystal Growth	Wisconsin Center for Automation and Robotics Center for Macromolecular Crystallography

* As of February 2000.
Key: STS—Space Transportation System

WELCOME TO INNOVATION

NASA's Commercial Technology Network – An Overview

By Dr. Robert L. Norwood
Director, Commercial Technology Division
NASA Headquarters

WITH THE SPACE ACT OF 1958, CONGRESS gave NASA direction for leading America's space program and mandated the agency to work with U.S. industry. More than 40 years later, this partnership–NASA's technology transfer and commercialization program–has generated exciting new technologies in the United States and abroad that positively impact our economy and boost our global competitiveness.

In 1994, NASA Administrator Daniel S. Goldin announced a new initiative for a new way of doing business. NASA is to be commended for not only embracing the mission from Congress, but also for strengthening it in documents such as Administrator Goldin's *Agenda for Change,* which re-establishes NASA's commitment to work with industry, implementing a new way of doing business, to move federally-funded R&D into the marketplace.

Technology transfer and commercialization is important to our economic well-being. The NASA Commercial Technology Network (NCTN) sees a huge industry demand for NASA technologies as U.S. companies reach out to public sector research and development. NASA established the NCTN as a foundation for its technology transfer and commercialization mission and has built an extensive infrastructure toward this end. It began with NASA's Centers of Excellence (Field Centers): Ames, Dryden, Goddard, Johnson, Kennedy, Langley, Lewis (now Glenn Research Center), Marshall and the Jet Propulsion Laboratory, and has expanded to include:

- Regional Technology Transfer Centers and the National Technology Transfer Center
- Commercialization and incubation centers
- Affiliated organizations

As we go forward in the new millennium, it is imperative to vigorously form and continue these partnerships essential to U.S. economic growth. Successfully utilized partnerships with industry, benefit not only the industrial customer and NASA, but also the economy and U.S. taxpayer.

While NASA's role at the cutting edge of research in space exploration is well known, the potential commercial applications of this effort are equally inspiring and renowned. The benefits of NASA technology are wide ranging—from home water filters and athletic shoes to advances in medical research, airline safety and fire fighting techniques. The application of NASA's technologies also contribute to the creation of jobs, companies, and industries. Understanding gained through NASA research and space exploration promotes more effective skills in a wide range of everyday technologies and aids in producing and processing many materials, including metals, semiconductors, polymers and glass. We drive cars and fly airplanes that were designed using NASA computer software. We live in homes constructed with insulation material that was developed using NASA technology. We work in office buildings that carry electricity through flat conductor cables that incorporate NASA technology.

The International Space Station (ISS) will provide the opportunity for long-term research that can be applied to commercially viable products and processes. Economic development of low-Earth orbit is a priority goal of the ISS. With the ISS now in orbit, new frontiers in human space exploration, technology and business have opened. The ISS will provide more space for research, with greater resources and flexibility than any spacecraft ever built. Companies will have unprecedented access to the space environment to perform long-term research that can be applied to the development of new products and processes. Such research will support the development of new markets and industries, enhance America's competitiveness in the international marketplace and provide economic benefits to people on Earth.

Many other examples will result from NASA's strategic focus to advance and communicate scientific knowledge and understanding of Earth and space, to explore, use, and enable the development of space for human enterprise and to research, develop, verify and transfer advanced aeronautics, space and related technologies.

Yesterday's accomplishments coupled with today's innovations pave the way for tomorrow's advances as NASA's commercial technology program continues to focus its efforts on the incorporation of our technologies into state-of-the-art products and services. With a continued emphasis on partnering with industry, companies have transferred NASA know-how into products and services that affect and enhance our quality of everyday life.

All of us in the NCTN look forward to continuing NASA's dynamic role of expanding the horizon of knowledge, while benefiting humanity through new commercial products and services well into the new century and beyond.

Extending the Reach of NASA Technology

SINCE NASA'S INCEPTION IN 1958, THE AGENcy's aeronautics and space programs have produced and sponsored advanced research and technology involving a broad range of technical disciplines and industries. The commercial and secondary application of this great wealth of innovation and knowledge has yielded—and continues to generate—substantial dividends for U.S. enterprises, economic growth and quality of life. The harvesting of NASA's technological resources originated with the Space Act of 1958 creating NASA, which mandated the wide dissemination of the agency's R&D results. Forty-two years later, NASA's pioneering commitment to technology transfer and commercialization continues to extend the reach of NASA across the nation, resulting in the innovative application of NASA technology and know-how throughout the economy and our daily lives.

NASA's mission to foster technology partnerships for NASA programs and commercial purposes and to facilitate the transfer and commercialization of NASA-funded research and technology is served today by a national network of technology transfer and commercialization organizations sponsored by and affiliated with NASA. The network, known as the NASA Commercial Technology Network (NCTN), is dedicated to providing services and assistance to U.S. entrepreneurs and enterprises in moving technology from the laboratory to the marketplace in partnership with NASA. The NCTN operates under the strategic direction of the Commercial Technology Division at NASA Headquarters, and consists of the Commercial Technology Offices at each of the ten NASA Field Centers, the NASA Regional Technology Transfer Centers, the National Technology Transfer Center, NASA-sponsored business/technology incubators, and other specialized organizations and services. The NCTN organizations operate in all 50 states in partnership with local business and government resources to connect U.S. firms and entrepreneurs with NASA technology opportunities and to assist the commercialization of NASA-funded technology.

In addition to the physical presence of the network across the nation and its involvement in numerous business sectors, NASA has further expanded its reach through the online NCTN. This online network encompasses the Web sites and services of the NCTN organizations, and has enabled unprecedented access to NASA technology and partnership opportunities. It serves as an integrated information resource for available NASA technology and the technology commercialization capabilities and services of the NCTN. The core site for the online NCTN (*http://www.nctn.hq.nasa.gov*) is operated by the Commercial Technology Division at NASA Headquarters.

To explore NASA technology for your enterprise and to learn more about the NASA resources for technology transfer and commercialization, go online to the Web sites listed below.

The NASA Commercial Technology Network, listed below, includes private and public sector enterprises that complement and support the transfer and commercialization of NASA-sponsored technology.

NASA Commercial Technology Network

NASA Centers:

- NASA Headquarters, Commercial Technology Division, *http://www.nctn.hq.nasa.gov*
- Ames Research Center, Commercial Technology Office, *http://www.ctoserver.arc.nasa.gov*
- Dryden Flight Research Center, Commercialization Office, *http://www.dfrc.nasa.gov*
- Goddard Space Flight Center, Technology Commercialization Office, *http://www.gsfc.nasa.gov*
- Glenn Research Center, Commercial Technology Office, *http:// www.grc.nasa.gov*
- Jet Propulsion Laboratory, Commercial Technology Office, *http://www.jpl.nasa.gov*
- Johnson Space Center, Commercial Technology Office, *http://www.jsc.nasa.gov*
- Kennedy Space Center, Technology Programs and Commercialization Office, *http://www.ksc.nasa.gov*
- Langley Research Center, Technology Commercialization Program Office, *http://www.larc.nasa.gov*
- Marshall Space Flight Center, Technology Transfer Department, *http://www.msfc.nasa.gov*
- Stennis Space Center, Technology Transfer Office, *http://www.ssc.nasa.gov*

Technology Transfer Centers:

- National Technology Transfer Center (NTTC), *http://www.nttc.edu*
- Regional Technology Transfer Centers (RTTCs):
  - Far West (AK, AZ, CA, HI, ID, NV, OR, WA) — Far West Regional Technology Transfer Center (FWRTTC), *http://www.usc.edu/dept/engineering/TTC/NASA*
  - Mid-Atlantic (DC, DE, MD, PA, VA, WV) — Mid-

Atlantic Technology Applications Center (MTAC), *http://oracle.mtac.pitt.edu/WWW/MTAC.html*

- Mid-Continent (AR, CO, IA, KS, MO, MT, ND, NE, NM, OK, SD, TX, UT, WY) — Mid-Continent Technology Transfer Center (MCTTC), *http://www.mcttc.com*
- Mid-West (IL, IN, MI, MN, OH, WI) — Great Lakes Industrial Technology Center (GLITeC), *http://www.battelle.org/glitec*
- Northeast (CT, MA, ME, NH, NJ, NY, RI, VT) — Center for Technology Commercialization (CTC), *http://www.ctc.org*
- Southeast (AL, FL, GA, KY, LA, MS, NC, SC, TN) — Southern Technology Applications Center (STAC), *http://www.state.fl.us/stac*

NASA-sponsored Incubators:

- The Ames Technology Commercialization Center (ATCC), *http://ctoserver.arc.nasa.gov/incubator.html*
- BizTech, *http://europa.uah.edu/biztech/index.html*
- The Emerging Technology Center (ETC), *http://www.etcbaltimore.com/index2.html*
- The Florida/NASA Business Incubator Center (FNBIC), *http://technology.ksc.nasa.gov/FNBIC*
- The Hampton Roads Technology Incubator (HRTI), *http://www.hr-incubator.org*
- The Lewis Incubator for Technology (LIFT), *http://www.liftinc.org*
- The Mississippi Enterprise for Technology (MET), (Web site not available)
- The NASA Commercialization Center (NCC), *http://www.nasaincubator.csupomona.edu/home.htm*
- The UH-NASA Technology Commercialization Incubator, *http://www.research.uh.edu/otm/techmanage.html*

Specialized Centers and Services:

- NASA Technology Applications–Research Triangle Institute (RTI), *http://www.rti.org*
- NASA/MSU TechLink Center, *http://techlink.msu.montana.edu*

The efforts of NASA's Commercial Technology Network will contribute to the continued preeminence for the United States, not only in matters of science and technology, but also in the transfer of technology to private industry. This will result in commercially developed products and services, facilitating a continued global leadership position for our economy, as well as benefits for humankind in general.

Shuttle Fuels Life-Saving Efforts

THE SAME ROCKET FUEL THAT HELPS POWER the Space Shuttle as it thunders into orbit will now be taking on a new role that could potentially benefit millions of people worldwide.

Leftover rocket fuel from NASA is being used to make a new flare that destroys land mines where they were buried, without using explosives. The flare was developed by Thiokol Propulsion in Brigham City, Utah, the NASA contractor that designs and builds rocket motors for the Space Shuttle.

Thiokol is using the surplus propellant through an agreement with Marshall Space Flight Center (MSFC) in Huntsville, Alabama. "Clearly, this project has the potential to save lives worldwide," said MSFC Director Arthur G. Stephenson. "Marshall is happy to help in this humanitarian endeavor."

The flare is safe to handle and easy to use. People working to deactivate the mines — usually members of a military or humanitarian organization — simply place the flare next to the uncovered land mine and ignite it from a safe distance using a battery-triggered electric match. The flare burns a hole in the land mine and ignites its explosive contents. The explosive burns away, not detonates, disabling the mine and rendering it harmless.

Occasionally, the mine detonates before the explosive is fully consumed. When this occurs, the explosion is more controlled and minimized, causing less damage than other mine-disposal methods, according to Charles Zisette, Thiokol program manager. Other methods include deactivation by hand or deliberate detonation, both highly dangerous processes.

An estimated 80 million or more active land mines are scattered around the world in at least 70 countries. Land

Surplus rocket fuel from Space Shuttle launches is being used to destroy land mines where they are buried. Thiokol Propulsion, the contractor that designs and builds rocket motors for the Space Shuttle, designed the flare in collaboration with DE Technologies, Inc.

mines kill or maim 26,000 people a year, most of them women or children, and usually after military hostilities have ended. Worldwide, there is one land mine-related casualty every 22 minutes.

Using leftover rocket fuel to help destroy land mines incurs no additional costs to taxpayers. To ensure enough propellant is on-hand for each Shuttle mission, NASA allows for a small percentage of extra propellant in each batch. Once mixed, surplus fuel solidifies and cannot be saved for use in another launch. In its solid form, however, it is an ideal ingredient for Thiokol's new flare.

Thiokol Propulsion is a division of Cordant Technologies Inc. The flare was conceived in collaboration with DE Technologies, Inc. of King of Prussia, Pennsylvania. MSFC is NASA's lead center for developing space transportation and propulsion systems.

For more information, visit *http://www.msfc.nasa.gov/news,* or contact Jerry Berg at Marshall Space Flight Center, 256/544-0034, *jerry.berg@msfc.nasa.gov* Please mention you read about it in *Innovation.*

Economic Impacts Likely With Partnership

AMES RESEARCH CENTER DIRECTOR DR. Henry McDonald and San José State University (SJSU) President Dr. Robert Caret recently signed a Memorandum of Understanding (MOU) to establish a partnership that officials believe will have a major impact on the economic and social development of Silicon Valley.

Ames and SJSU are working together to plan future research and development (R&D), technology commercialization and education partnerships at Ames Research Center's NASA Research Park, according to the terms of the agreement.

"Our goal is to develop a world-class, shared-use R&D campus by partnering with industry, academia and nonprofits in the NASA Research Park," McDonald said. "I am delighted to form this partnership with San José State University to conduct joint research in cutting-edge technologies and to develop new ideas to improve the region's education infrastructure," he said.

"Partnerships between business, government and education are going to be absolutely crucial to our future," Caret said. "This partnership is an example of where we are headed in the next century," he said.

"We are planning MOUs with the University of California at Santa Cruz, Stanford University and Foothill-DeAnza Community College for R&D collaborations and educational programs at the NASA Research Park," said Ames Chief of Development and Communication Michael Marlaire. "San José State University is an outstanding partner in the areas of education and workforce development, technology commercialization, disaster assistance and information technology research," he said.

"The partners will work with local colleges, such as Foothill-DeAnza and the National Hispanic University, to develop the workforce of tomorrow with an emphasis on underrepresented minority groups," said Dr. Nabil Ibrahim, San José State University Associate Vice President. "We will provide hands-on world-class education and training with some of the valley's preeminent high technology companies at the NASA Research Park," he said.

Collaborations will include the development of K-12 science, math, engineering and technology programs; development of a teacher institute; and graduate, credential and extended education programs. The agreement envisions developing information technology for disaster research and application, including satellite remote sensing, signal processing and instrumentation. The two organizations will also collaborate in research involving human factors and information science.

Ames Research Center is NASA's leader in information technology, astrobiology and aerospace operations systems. San José State University is among the state's top 10 organizations receiving monetary awards from NASA.

For more information, *visit http://ccf.arc.nasa.gov/dx* or contact Michael Mewhinney at Ames Research Center, 650/604-3937 or 650/604-9000, *mewhinney@mail.arc.nasa.gov* Please mention you read about it in *Innovation.*

Patented Polymers Technique Commercialized

AN OHIO COMPANY IS COMMERCIALIZING A NASA-patented technique to produce superior corrosion control coatings under a license agreement with Kennedy Space Center's Technology Programs and Commercialization Office. GeoTech Chemical Company

of Tallmadge, Ohio, plans to market products under the Catize™ name, beginning sometime after January, according to GeoTech Vice President Christopher Geer.

GeoTech plans to merge their patented corrosion control system with the NASA/KSC Ligno Sulfonic Acid Doped Polyaniline (Ligno-Pani) technology, an Inherently Conductive Polymer (ICP) also referred to as a synthetic metal. Products will be available to the entire coatings industry in the form of an additive.

The GeoTech facility where Ligno-Pani production is being executed will require some capital equipment expenditures, as well as increased numbers of technical and production personnel on staff. A new facility requiring further capital equipment is necessary to manufacture the coatings additive.

Cost effective manufacturing of Ligno-Pani is a key competitive advantage. Its compatibility with other chemistries, versus other ICPs, will provide a wider potential for products and applications to target. Identifying Ligno-Pani's potential in numerous electronic products and applications is underway, with anticipated results of several new applications later this year.

Conductive polymers work has been part of NASA's corrosion control for many years. In 1997, KSC's Material Science Laboratory (MSL) entered into a grant contract with Dr. Tito Viswanathan of the University of Arkansas at Little Rock for antistatic coatings for clean room garments in hazardous atmospheres. The antistatic coating ensures that there is no potential for sparking and igniting a combustible atmosphere. Sample clothing coated with the chemical retained its conductivity after 50 washes, according to KSC technical lead Coleman Bryan.

This inexpensive and environmentally safe technology and this developed method increases the solubility and processability of electrically conducting polymers. The resulting polymers can be used in applications such as electronics, antistatic coatings, corrosion prevention, photolithography and electromagnetic interference (EMI) shielding.

The technology offers several advantages, including the use of inexpensive materials, such as aniline and lignin. Lignin is a paper and pulp manufacturing waste product. Unlike existing coatings and systems used for corrosion prevention, Ligno-Pani does not utilize ozone-depleting, volatile, organic compounds or heavy metals that pollute the water supply.

Many existing products may be improved by using Ligno-Pani, according to GeoTech. Ligno-Pani can reduce the cost and extend the life cycle of many household items, such as computers, televisions and cellular phones. Its ability to extend the life cycle of structural steel used in buildings, bridges, and marine equipment will have a dramatic economic impact in every society. An example is the use of the ICP in coatings for corrosion control, since corrosion costs are estimated at $200 billion annually, 4.2 percent of the U.S. Gross National Product.

"The possibilities are exciting and endless and I am confident to say that Ligno-Pani will have an impact on the world as we know it today," Geer stated. He also pointed out other potential uses, including conductive inks, pH and moisture sensors, nonlinear optical (NLO) materials, stealth technology (radar invisible coatings), electrostatic dissipation (ESD) in packaging application, high temperature conducting adhesives, smart windows, radar/microwave absorption, batteries, capacitors, redox actuators, light emitting diodes (LEDs), transistors, sensors and drug delivery systems.

For more information, contact Melanie Chan at Kennedy Space Center's Technology Programs & Commercialization Office, 407/867-6367, *melanie.chan-1@ksc.nasa.gov* Please mention you read about it in *Innovation*.

NEW EDUCATIONAL PARTNERSHIP WITH INDUSTRY

Ames Research Center (ARC) has signed a Memorandum of Understanding (MOU) with Lockheed Martin Space Operations, the first of its kind with industry that forms a planning partnership to conduct joint research in cutting-edge technologies and to develop new ideas to improve the nation's education infrastructure.

"This is the first time that a government agency and a national aerospace corporation have agreed to work together as part of the development of a world-class, shared use R&D campus like the NASA Research Park," said Ames Research Center Director Dr. Henry McDonald.

"This partnership with Ames is an important first step in our new approach to commerce in the next century, and we hope to develop collaborations with other NASA Research Park partners," said Lockheed Martin President Jay Honeycutt.

"Our first opportunity will be to work with NASA on a variety of critical R&D initiatives, with an emphasis on Astrobiology," Honeycutt said. "We also plan to focus on life and microgravity sciences, biotechnology, aeronautical and space technology development, education and workforce development, technology commercialization, and information technology research."

Headquartered in Bethesda, Maryland, Lockheed Martin is a global enterprise principally engaged in the research, design, development, manufacture and integration of advanced technology systems, products and services.

For more information, contact Michael Mewhinney at Ames Research Center, 650/604-3937, 650/604-9000, *mmewhinney@mail.arc.nasa.gov* Please mention you read about it in *Innovation*.

Gas Sensor Reduces Cost, Size

JET PROPULSION LABORATORY (JPL) WILL assist Ion Optics, Inc., a Waltham, Massachusetts-based company, to develop an infrared "gas sensor-on-a-chip" that re-duces the size and cost of equipment under terms of a new Advanced Technology Program award from the Department of Commerce's National Institute of Standards and Technology.

The new microelectromechanical systems sensor reduces an expensive piece of equipment to one circuit, cutting down size and expense. It integrates elements of high-end industrial gas and chemical sensors onto a single chip that can be manufactured in high volume at low cost, taking advantage of new silicon integrated chip manufacturing techniques developed at JPL.

THE NEW SENSOR REDUCES AN EXPENSIVE PIECE OF EQUIPMENT TO ONE CIRCUIT, TAKING ADVANTAGE OF NEW TECHNIQUES DEVELOPED AT JPL.

These techniques will provide an accurate and reliable gas sensor for such mass market applications as carbon monoxide detectors, and water and indoor air quality monitors. Additional applications include automobile exhaust monitoring, automobile "cabin" air quality, gasoline vapor emissions monitoring, oil quality monitoring, gas leak detectors, home food spoilage monitors, home fire/kitchen smoke detectors and non-invasive blood glucose monitoring.

Each application involves a sensor chip that works at a specific spectrum for that gas. JPL will use electron beam lithography techniques that allow for creating precisely controlled, nanometer-sized features on the sensor's surface.

This new "sensor-on-a-chip" approach replaces separate component instruments in much the same way integrated circuits have replaced large electronic systems. The device will be more reliable and have greater accuracy than electrochemical sensors, and it will have reduced maintenance requirements over its expected operating life of 10 to 20 years.

Infrared gas and chemical sensors have historically served as reliable measurements of choice for specialized instruments in niche markets. Conventional infrared sensors have not achieved penetration into mass markets because of high costs. Simpler, standardized integrated chip component technology is needed to bring these high-quality sensors to mass markets.

The Advanced Technology Program is a partnership between government and private industry to accelerate the development of high-risk technologies that promise significant commercial payoffs and widespread benefits for the economy. The three-year award to Ion Optics specifies that JPL is to assist in sensor technology development. JPL is a division of the California Institute of Technology, Pasadena, California.

For more information, contact Franklin O'Donnell at Jet Propulsion Laboratory, (818) 354-5011 or access *http://www.jpl.nasa.gov* Please mention you read about it in *Innovation.*

NASA Assists Echocardiography Lab Design

MISSION CONTROL AT JOHNSON SPACE Center's (JSC) Emergency Preparedness Center was the model used to develop a cutting-edge echocardiogram facility through a partnership between JSC and the Heart Center at Texas Children's Hospital in Houston. Architects designing Texas Children's current 1.2 million square foot expansion asked the Heart Center staff to identify existing facilities they believed were on the cutting-edge of technology.

"High on our list was NASA Mission Control," said Dr. J. Timothy Bricker, chief of cardiology at Texas Children's Hospital. "We have to respond to a lot of information quickly, with no technical errors, just like they do."

An echocardiogram is a non-invasive test that uses ultrasound to examine the structure and functioning of the heart for abnormalities and disease. Last year Texas Children's read 10,000 echoes, some coming from various departments within the hospital and some from other hospitals in the region.

The immediate and productive chemistry between JSC and Texas Children's staff produced a "mission control," a quiet, dark and intense reading room, lined with television monitors with screen images of children's beating hearts.

"When you put creative, intelligent people together, sparks just fly," Bricker said. "We enjoyed getting their input, and you could see them tucking away things we do that might be of benefit to NASA. Their input was valuable as we looked at designing the lab of the future."

"One of NASA's jobs is to make space technology available to improve life on Earth," said JSC director George W.S. Abbey. "We are delighted to see this technology being used at Texas Children's to help young patients get well."

The partnership also brought positive responses from the staff of Texas Children's Heart Center. "Our staff is excited, enthusiastic and confident that we have planned well for Texas Children's function to take care of kids now and into the next century and to provide service to the hospital and region, and even worldwide," Bricker said.

Bricker also sees similarities between the work of his department and NASA. "Like NASA, pediatric car-

NASA, INTERNATIONAL SCIENTISTS EXAMINE OZONE

NASA scientists this winter have joined researchers from Europe, Russia, Canada and Japan to assess amounts and changes in the Arctic ozone, the part of the upper atmosphere protecting life below from radiation that can damage DNA molecules and lead to skin cancers.

Using a large suite of instruments, the collaborative campaign will measure ozone and other atmospheric gases using satellites, airplanes, heavy-lift and small balloons, and ground-based instruments. From November 1999 through March 2000, researchers will examine the processes that control ozone amounts during the Arctic winter at mid to high latitudes.

A spectrometer to measure atmospheric gases is being loaded on NASA ER-2 aircraft. One of many instruments being used, it will sample free stream air as part of an international Arctic Ozone examination expedition.

"The combined campaign will provide an immense new body of information about the Arctic stratosphere," said program scientist Dr. Michael Kurylo, NASA Headquarters, Washington, D.C. "Our understanding of the Earth's ozone will be greatly enhanced by this research."

The Earth's ozone layer protects life below from the harmful ultraviolet radiation coming from the Sun. Very low levels of ozone were observed over the Arctic in several winters during the 1990s, raising concerns that an Arctic ozone hole might be forming. Recent modeling work has suggested that greenhouse gas warming might lead to larger-than-expected Arctic ozone losses in the future and also may delay the expected recovery of the ozone layer globally.

For more information, visit *http://cloud1.arc.nasa.gov/solve/index.html* and *http://www.ozone-sec.ch.cam.ac.uk*

Staff at the state-of-the-art echocardiogram facility in the Heart Center at Texas Children's Hospital, modeled after Mission Control at Johnson Space Center's (JSC) Emergency Preparedness Center, will use their own "mission control" to study ultrasounds of children's hearts.

diology doesn't have a second chance. We both have to do things right the first time," he said.

"The result of the alliance," said Mary Beth Mauer, a director at the Texas Children's Heart Center, "is a cutting-edge facility that allows for integrated training and operation, expandability, operating cost reduction and better patient diagnosis and care."

"NASA helped with flow of information and suggested technologies to help data travel from patient to doctor," Mauer said. Aspiring astronauts will appreciate another result of the collaboration with NASA. The Texas Children's Heart Center plans to stock the new clinic's waiting rooms with space-related toys.

For more information, contact John Ira Petty at Johnson Space Center, 281/483-5111, *john.i.petty1@jsc.nasa.gov* Please mention you read about it in *Innovation.*

NASA's Refined Technique Helps Farmers

SCIENTISTS AT THE GLOBAL HYDROLOGY AND Climate Center at Marshall Space Flight Center (MSFC) are collaborating with university researchers to apply remote sensing technology developed for the space program to a sophisticated agricultural technique to help improve crop management and increase profitability.

The technique, called precision farming, could mean the difference between "boom" and "bust" for American farmers in the new millennium because the availability of inexpensive agricultural products for consumers in the next century could depend on such capabilities.

In precision farming, growers break fields down into regions, or "cells," analyzing growth characteristics of each cell and improving crop health and yield by applying precise amounts of seed, fertilizer and pesticides as needed. Traditionally, farmers fertilized their crops, simply by spreading it uniformly across the entire field.

Another societal benefit is preventing excess nitrogen leakage into groundwater, according to Paul Mask, professor of agronomy at Auburn University in Auburn, Alabama. "Other fertilizers can increase pollution problems, threatening public health. By adding only the amount of fertilizer the land and the crop can effectively use, we can reduce such problems."

"We can point to areas that will always have low yield," adds Mask. "If the maximum capability of an area is 50 bushels an acre, there is no need to fertilize for 120 bushels. It does no good. The true potential is not simply improving yield," Rickman agrees. "It's improving stewardship of the land."

Remote sensing is the gathering of data for analysis by instruments that are not in physical contact with the objects of investigation, commonly via planes or orbiting satellites. Remote sensing is used to measure electromagnetic radiation, including the thermal energy that is reflected or emitted in varying degrees by all natural and synthetic objects, such as crops.

"Farmers have sought this ability for 30 years," said Doug Rickman, lead researcher for the Global Hydrology and Climate Center.

When NASA began studying precision agriculture techniques in the 1970s, the practice was hampered by researchers' inability to accomplish precise mapping plant quality and soil makeup. Measuring yield was also inconvenient, time-consuming and often imprecise, sending soil samples to a lab, and waiting days or weeks for the results.

The advent of global positioning systems and remote sensing technology changed all that. "Now farmers can intelligently control their systems," Rickman says, "before they ever plant a seed."

"We're seeking to provide a system that will help farmers improve the efficiency of their fields and their crop management techniques," Rickman said. "In the end, that will benefit everyone."

For more information, contact Steve Roy at Marshall Space Flight Center, 256/544-0034, *steve.roy@msfc.nasa.gov* Please mention you read about it in *Innovation.*

X-43 Hypersonic Prepares for Spring Flight

THE FIRST OF THREE EXPERIMENTAL VEHICLES, designated X-43A, recently arrived at NASA's Dryden Flight Research Center in Edwards, California to prepare for flight in May 2000.

Flight of the X-43, the world's first hypersonic air-breathing free-flight vehicles, will be the culmination of over 20 years of scramjet (supersonic combustible ramjet) research and the first time a non-rocket engine has powered vehicles at hypersonic speeds.

Built by Micro Craft, Inc. of Tullahoma, Tennessee for NASA's Hyper-X program, the 12-foot-long, unpiloted X-43 vehicles will significantly expand the boundaries of air-breathing aircraft. Three flights are planned—two at Mach 7 and one at Mach 10. The flight tests will be conducted within the Western Test Range off the coast of southern California.

The Hyper-X program will build a technology bridge to reusable and recoverable vehicles with larger engines. Program managers hope to demonstrate hydrogen-powered, air-breathing propulsion systems that could ultimately be applied in vehicles from hypersonic aircraft to reusable space launchers.

Hypersonic speed is reached when velocity is above Mach 5—equivalent to about one mile per second, or 3,600 miles per hour at sea level. The highest speed reached by NASA's rocket-powered X-15 was Mach 6.7. Currently, NASA's SR-71 is the world's fastest air-breathing aircraft, soaring slightly above Mach 3, or three times the speed of sound.

Unlike a rocket that must carry its own oxygen for combustion, an air-breathing aircraft scoops air from the atmosphere, making the aircraft lighter and enabling it to carry more cargo/payload than rocket-powered propulsion vehicles. The X-43 will use the body of the aircraft itself to form critical elements of the engine with the forebody acting as the intake for the airflow and using the aft section as the nozzle.

Each Hyper-X vehicle will ride atop a booster rocket from Orbital Sciences Corp. of Dulles, Virginia, and will be air-launched by Dryden's B-52 airplane. After being launched from the B-52, the X-43 will separate from the rocket at a predetermined altitude and velocity, then fly a pre-programmed trajectory, conducting aerodynamic and propulsion experiments, before it impacts into the Pacific Ocean.

NASA's Langley Research Center in Hampton, Virginia, where the X-43's engine–scramjet–is being wind-tunnel tested, manages the Hyper-X program. Dryden is responsible for vehicle fabrication and flight tests.

For more information, contact Leslie Matthews at the Dryden Flight Research Center, 661/258-3458, *leslie.matthews@dfrc.nasa.gov* or Chris Rink at Langley Research Center, 757/864-6786. Please mention you read about it in *Innovation.*

In Phase 1 of the Hyper-X program, four 12-foot long, unpiloted aircraft will fly up to ten times the speed of sound to demonstrate "air-breathing" engine technologies.

NASA Opens Sky for Students

STUDENTS IN BALTIMORE, MARYLAND ARE using the latest computer software and hardware to discover the world of science and technology, including how to design an aircraft and plot its flight, under a NASA educational program.

Glenn Research Center in Cleveland, Ohio and Morgan State University in Baltimore have established a Science, Engineering, Mathematics and Aerospace Academy (SEMAA) for underserved middle-school students. SEMAA's purpose is to enhance the students' success and motivate greater numbers of young people to pursue careers in science, math and related fields.

"SEMAA WILL PLANT THE SEED OF INSPIRATION FOR OUR YOUNG PEOPLE TO STUDY MATH AND SCIENCE AND GAIN THE SKILLS THEY NEED."
–SENATOR BARBARA MIKULSKI

"Using NASA technologies and the educational expertise of Morgan State University, we will inspire a new generation of you to explore the space frontier," said NASA Administrator Daniel S. Goldin.

"These youngsters are the new generation for the new millennium," said Senator Barbara Mikulski of Maryland. "This is the generation that will grow up to become astronauts, engineers, researchers and computer experts. SEMAA will plant the seed of inspiration for our young people to study math and science and gain the skills they need in our increasingly high-tech economy."

The program features an Aeronautics Education Laboratory (AEL) in Morgan State's School of Engineering. AEL is a leap in classroom technology, a state-of-the-art, electronically enhanced computerized classroom that puts cutting-edge technology in the hands of students in grades six through nine. At 10 workstations, SEMAA students will explore satellite global positioning, remote sensing, amateur radio and aircraft design, and collect weather information in preparation for flight. The experience culminates with a virtual flight using a cockpit simulator or head-mounted display.

"I applaud Morgan State University and NASA for their shared commitment to this SEMAA Academy–the power and promise of young minds in pursuit of a very old dream. Their struggles for scientific achievement and educational opportunity arise from the same source: our shared humanity," said Congressman Elijah Cummings of Maryland. "When we offer everyone a place in our shared quest for the stars, the light of our own best nature will guide us along our way. When we walk together toward the starlight, everyone gains from the quest, however long our journey may take."

A vision of former Congressman Louis Stokes of Ohio, SEMAA was established in 1993 by Glenn Research Center and Cuyahoga Community College in Cleveland to foster understanding and enthusiasm in school-age children for science, math and technology fields. Since 1993, SEMAA has grown from a single location to multiple sites reaching thousands of children, from kindergarten through high school, and their families.

For more information, contact Lori Rachul at Glenn Research Center, 216/433-8806, *lori.rachul@grc.nasa.gov* Please mention you read about it in *Innovation.*

More Accurate Weather, Space Research

NASA WILL FLIGHT-TEST AN INSTRUMENT using new technologies to measure elements of Earth's atmosphere and to support space research aimed at reducing risks from severe weather. This measurement concept, known as the Geostationary Imaging Fourier Transform Spectrometer, is the next Earth-observing mission under NASA's New Millennium Program.

The mission–known as "Earth Observing 3"–will test advanced technologies for measuring temperature, water vapor, wind and chemical composition with high resolution, in space and over time. Such sophisticated measurements have the potential for revolutionary improvements in weather observation and prediction, by providing unique observations of

the spectral properties of clouds and the transport of pollutants in the atmosphere.

"In 2003, this space flight demonstration will involve genuinely revolutionary measurement approaches that will have a major impact on Earth system science," said Dr. Ghassem Asrar, NASA Headquarters' Associate Administrator for Earth Science, Washington, DC. "The eventual incorporation of this technology on geostationary weather satellites would provide up-to-the-minute information, never before available, on active severe weather systems, such as hurricanes and tornados.

"These observations will help improve the accuracy of the current three-day weather forecasts and extend the duration of forecasts up to five days during the next decade," Asrar said.

Managed by Langley Research Center in Hampton, Virginia, the mission uses an advanced imaging spectrometer based on breakthrough technologies such as a large-area focal-plane array, new data-readout and signal-processing electronics, and passive thermal switching. Today's geostationary satellites observe Earth, its atmosphere and oceans in only a few selected spectral bands. This new instrument will improve observational capabilities to several hundred spectral bands that will provide both additional and more detailed information.

NASA Headquarters selected this concept from an external peer review evaluation of four finalist ideas culled from 24 proposals submitted in response to a NASA research announcement released in September 1997. The theme for the solicitation was testing innovative approaches for observing Earth's surface and atmosphere from positions outside low-Earth orbits, with an emphasis on advanced measurement concepts and technologies.

The first Earth-orbiting mission under the New Millennium Program, Earth Observing 1, is scheduled for launch in spring of 2000. Managed by Goddard Space Flight Center in Greenbelt, Maryland, that mission will demonstrate an advanced land-imager system and hyperspectral imaging technologies that may eventually replace the current measurement approach used by Landsat satellites.

Created in 1994, the New Millennium Program is designed to identify, develop and flight-validate advanced technologies that can lower costs and enable critical performance of future science missions in the 21st century. The program is managed by NASA's Jet Propulsion Laboratory in Pasadena, California.

For more information, visit *http://nmp.jpl.nasa.gov, http://www.earth.nasa.gov,* or *http://eo1.gsfc.nasa.gov/NUwww/miscPages/home.html*

TECHNOLOGY COULD IMPROVE ARRIVAL TIMES

Air travelers frustrated with ever-increasing bad weather delays at the nation's airports may soon receive some relief. This could mean travelers arriving on-time at their destinations more often, financial savings for the airline industry and more efficient airports.

Langley Research Center, Honeywell Technology Center and Honeywell Airport Systems have developed new technology that could solve a significant part of the problem. In-flight demonstrations of the new system were conducted at the Minneapolis-St. Paul International Airport in early November for Federal Aviation Administration (FAA) officials and other government and industry representatives.

Called Airborne Information for Lateral Spacing (AILS) and Closely Spaced Parallel Approaches (CASPER), the systems expand on existing communication and navigation technology to allow planes to land safely in bad weather on parallel runways spaced as closely as 2,500 feet apart. This means no longer do some of the nation's busiest airports have to shut down their closely spaced runways when weather conditions deteriorate. Some of the airports where this new technology could improve on-time arrivals are Detroit, Seattle, Minneapolis and Memphis.

With the AILS/CASPER system, aircraft coming in to land "talk" to each other through Automatic Dependent Surveillance-Broadcast, a technology under development by the FAA and industry. Differential Global Positioning System signals provide precise information about each plane's location.

Simultaneous use of the Traffic Alert and Collision Avoidance System, AILS alerting functions, and simple, consistent pilot procedures assures safe approaches and landings.

For more information, contact Judi Tull at Langley Research Center, 757/864-3189, *j.tull@larc.nasa.gov* Please mention you read about it in *Innovation.*

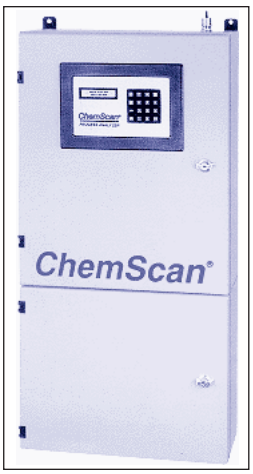
Space Life Support Analyzer Commercialized

A WISCONSIN COMPANY IS SUCCESSFULLY commercializing water analyzers originally designed for hydroponics monitoring under a Small Business Innovation Research (SBIR) contract sponsored by NASA at Kennedy Space Center (KSC).

Applied Spectrometry Associates (ASA), Inc. of Waukesha, Wisconsin has installed over 100 ChemScan® systems at industrial and municipal facilities, including multiple parameter systems at major cities like Austin, Texas; Calgary and Edmonton, Alberta, Canada; Gainesville, Orlando and Tampa, Florida; Las Vegas, Nevada; Los Angeles, California; New York City; Phoenix, Arizona; and Seoul, South Korea.

ASA President Bernie Beemster said his company is offering four models of its process analyzers. ASA bought the manufacturing rights from Biotronics Technologies, Inc., also of Waukesha, who originally worked with the KSC Biomedical Office under the SBIR contract to develop the analyzer.

Commercially, process analyzers are used to measure multiple chemicals at municipal drinking water treatment plants and municipal wastewater treatment plants, or in industrial water chemistry processes. Typical applications for process analyzers are large flow volumes, a dynamic chemical matrix, and a substantial motive to obtain real-time chemical analysis information, according to Beemster. In 1998 ASA added a new model to its ChemScan® product line, the UV-2150 Process Analyzer, offering improved reliability and reduced operation and maintenance cost for automatic analysis of ammonia or phosphate in water.



Water analyzers originally designed, under a SBIR contract sponsored by Kennedy Space Center, for monitoring hydroponic plant nutrients in the Bioregenerative Life Support System (BLSS) program are being commercialized. ChemScan® Process Analyzers are being used to measure chemicals at municipal drinking water treatment plants and municipal wastewater treatment plants.

NASA needed a water chemistry analyzer for monitoring hydroponic plant nutrients in the Bioregenerative Life Support System (BLSS) program to support developing systems to resupply food, water and air, not from Earth, but from the carbon dioxide they expel based on plant production systems.

The ChemScan® analyzers can be applied to various municipal water and industrial processing plants, saving money due to low maintenance times and online monitoring, either in-plant or at remote locations. These analyzers require only a few hours each month for maintenance, including the time required for preparation of reagents. Very little time is required for calibration verification or adjustment, and no time is required for recalibration. According to Beemster, customers using this analyzer say it requires less maintenance than any other chemical analyzer in their facility. Reliability is the most important attribute for a process analyzer, particularly if the output from the analyzer is going to be used as data for operation or adjustment of a treatment process.

ChemScan can detect any chemical substance that absorbs light in the ultraviolet or visible wavelength range. Ions of nutrients, ions of heavy metals that form coordination compounds in water, unsaturated (double bonded or triple bonded) hydrocarbons and aromatics are usually good candidates for analysis using ultraviolet or visible spectrometry. Chemicals that possess natural absorbance characteristics can be detected directly using primary absorbance techniques.

For more information, contact Lew Parrish at Kennedy Space Center, 407/867-6373, *lewis.parrish-1@ksc.nasa.gov* Please mention you read about it in *Innovation.*

Ignition System Improves Performance

INITIAL TESTS OF A NEW CATALYTIC IGNITION (CI) system on a standard general aviation engine have successfully demonstrated the system's ability to improve engine performance while operating on multiple fuels, including Avgas, 87UL and Jet-A, without the use of magnetos.

The CI technology was originally developed by Automotive Resources, Inc. of San Diego, before being transferred to AquaLytic Technologies, Inc. (ATI) of Sandpoint, Idaho, and improved upon under a Glenn Research Center (GRC) Phase I SBIR contract for the General Aviation Propulsion (GAP) program.

Performance improvements include increased power, reduced noise and vibration, increased lean limits, and the ability to maintain engine power without any electrical power. The CI technology, referred to as

the "SmartPlug," utilizes a heated catalyst mounted inside a small precombustion chamber, with the fixed position of the catalyst determining the engine ignition timing at all rpm. An integral DC heater brings the catalyst to operational temperature for initial operation, but no electrical power is required to sustain combustion during normal operation on unleaded fuels.

Flame jets from the precombustion chamber are injected into the cylinder, producing a very smooth and thorough combustion process. Roughly the same size as a sparkplug, the SmartPlug merely replaces sparkplugs in standard low-compression engines, while timing and high voltage system components are eliminated.

The CI system was tested on a reconditioned 0-200 Continental engine. Concurrent development efforts for the CI system include small, two-stroke multi-fuel (diesel included) engines for military applications, and operation of standard internal combustion engines on aqueous alcohols.

Multiple commercial applications from ATI's continued development of the CI technology include general aviation, where the technology could eventually contribute to improved safety and reduced environmental emissions. Using the CI system, general aviation aircraft could operate flawlessly even with contaminated or improperly substituted fuels, and without dependence on magnetos. The target is eventual compliance with FAR Part 33.37 for Ignition Systems, with demonstration of "an ignition system of equivalent in-flight reliability."

For the general aviation engine tests, static testing of a reconditioned 0-200 Continental engine was conducted using Avgas (100LL) and 87UL fuels, producing baseline results of 2400 rpm at wide-open-throttle (WOT). Sparkplugs and magnetos were removed and replaced by CI igniters and retested. With just one igniter per cylinder, CI performance matched spark-magneto performance on 100LL and 87UL. When the CI-configured engine was switched to Jet-A fuel (stock, carbureted), the engine rpm at WOT increased to 2475 rpm, with no visible exhaust emissions (spark-magneto configuration could not be tested with Jet-A). Noise level at five feet was reduced by six dB when switched from spark-magneto to CI igniters on 87UL, with a significant reduction in engine vibration as well. Cylinder head, barrel and exhaust gas temperatures for the CI-equipped engine were consistent with spark-magneto norms.

While continued DC heater power was required for operation on 100LL, due to catalyst poisoning, all electrical power could be shut off without significantly impacting engine performance on 87UL or Jet-A fuels–a major safety advantage with the next generation of unleaded aviation fuels.

The company's major partner for CI technology applications is 2 Stroke International (2SI, Beaufort, South Carolina), a developer and manufacturer of commercial and military two-stroke engines.

Previous tests have demonstrated its ability to allow standard two-stroke gasoline engines to operate on diesel fuel with no visible exhaust emissions, and tests using aqueous alcohol (140 proof) in a four-stroke gasoline engine demonstrated a 20% increase in horsepower with major reductions in NOx (97%), CO (94%) and HC (64%), with a 50% increase in thermal efficiency.

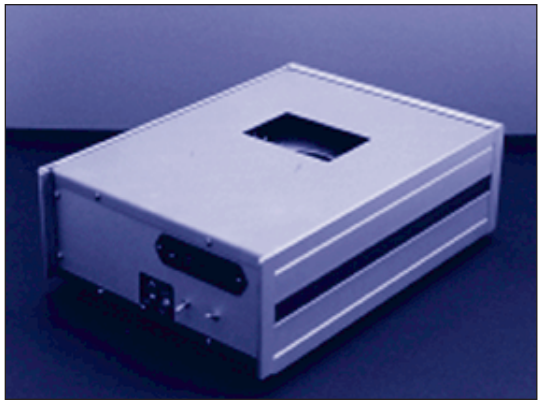
ATI is being assisted by MSU TechLink, a technology transfer and commercialization center in Bozeman, Montana working with NASA, the Department of Defense, and additional commercial firms, for technology development and new applications. Additional assistance has been provided by the Idaho SBDC in Boise.

For more information, contact Ray Friesenhahn at MSU Techlink, 406/994-7726, *rayf@montana.edu*, or Bill Burnett at AquaLytic Technologies, Inc., 208/265-2723, *smartplug@aol.com* Please mention you read about it in *Innovation.*

Contamination Monitoring Technology Commercialized

THE AEROSPACE ENGINEERING GROUP (AEG) of IDEA, LLC in Beltsville, Maryland is working with Kennedy Space Center (KSC) in a Cooperative Agreement to commercialize a KSC-developed automated fallout monitoring contamination detection system to benefit both NASA and private industry.

The Florida/NASA Business Incubation Center provided AEG an office and laboratory operations at the Palm Bay, Florida Open Access Cleanroom. The company has experience in developing contamination-sensitive spaceflight hardware and is aware of the potential problems that can result from fallout. AEG is interested in helping not only the aerospace community, but commercial industries as well, including computer manufacturers and medical research and equipment industries. The Agreement's purpose is to jointly develop a manufacturing prototype Active Particle Fallout Monitor (APFM) system based on the NASA-developed prototype capable of measuring particulate fallout accumulation in KSC cleanrooms.



The Aerospace Engineering Group (AEG) of IDEA, LLC is working with Kennedy Space Center (KSC) to commercialize a KSC-developed automated fallout monitoring contamination detection device. AEG and KSC will jointly develop a manufacturing prototype Active Particle Fallout Monitor system based on the NASA-developed prototype.

The one-year agreement calls for IDEA to evaluate the system capability and performance, its market potential, quantify system reliability, and improve system performance. This work will culminate in production of a manufacturing prototype and accumulation of data contained in a final project report that will be furnished to NASA.

NASA developed and patented a particulate fallout contamination detection instrument that directly images, sizes, and counts contamination particles. IDEA has obtained license rights to it and another patented KSC-developed technology to help them with the project. One is an exclusive license to commercialize the "Detector for Particulate Surface Contamination" (now called the APFM), developed by the NASA Contamination Monitoring Laboratory (CML) and the former KSC Engineering Support Contractor I-NET, Inc. The second license is non-exclusive, for the "Particle Fallout/Activity Sensor," also developed by the CML and I-NET.

Particle fallout is a contamination source that concerns NASA and aerospace-related industries. Depending on the type and size of the particles, fallout can be a source of contamination that could affect the performance of sensitive spaceborn instruments and support equipment. KSC and other centers have been aware of this issue for several years and have sought to develop different types of monitoring systems that are designed to alert spacecraft and spaceflight hardware developers and customers of possible fallout problems.

Historically, particle fallout has been measured by placing witness plates in several areas near critical spaceflight hardware, and then, collecting the plates after a determined period of exposure. These plates are then subjected to examination under a microscope, where trained technicians count and size the particles over the covered area. This method is painstakingly slow and requires many hours of personnel resources. AEG hopes to further develop the NASA prototypes into an automatic system.

The first licensed technology is a real-time monitor that can quantitatively measure (count and size) particulate fallout contamination. This device distinguishes between particles and fibers (aspect ratio greater than 10:1) and counts them as well as measuring and reporting their dimensions. The device directly images each particle and uses image processing algorithms in order to locate and size particles as well as to compensate for optical "holes" in particles, as well as "spiraled" fibers.

The second technology, also called the Real-time Optical Fallout Monitor (OFM), is a portable, optoelectronic instrument that uses a light scattering technique to measure the accumulation of particles. The OFM was developed in response to a NASA need to accurately detect and monitor the accumulation of potentially damaging environmental contamination (e.g., dust, fibers, or condensing vapor) on sensitive payload components in real time. This improves NASA's ability to mitigate, avoid, and/or explain mission-compromising incidents of contamination occurring during ground processing and, potentially, flight operations.

For more information, contact Melanie Chan at the Technology Programs & Commercialization Office (MM-E) at Kennedy Space Center, 407/867-6367, *melanie.chan-1@ksc.nasa.gov* Please mention you read about it in *Innovation.*

SBIR Phase II Proposal Selection

IN ACCORDANCE WITH THE GOVERNMENT Performance and Results Act (GPRA) of 1993, NASA is required to demonstrate, among other attributes, the contribution of its programs to the nation's economic well being. Consistent with GPRA, NASA's 1998 Strategic Plan includes commercial relevancy of NASA-funded technology as a primary mission goal. Under its Strategic Plan, NASA is also obliged to measure the commercial relevancy of its programs. As part of that measurement effort, NASA has designed and implemented a metrics system for quantifying commercial activity associated with its Small Business Innovation Research (SBIR) program. The primary purpose of NASA's SBIR program is to meet NASA mission-related technology needs by tapping the capabilities of small, high technology firms, and thus contribute to the continued viability of the Nation's small business sector. Although commercial application of NASA-funded SBIR technology is therefore a secondary objective and an added benefit, it is nonetheless an imperative under GPRA and NASA's

Strategic Plan.

Accordingly, NASA's SBIR solicitation emphasizes the importance of commercial potential of NASA-funded SBIR technology. In particular, the solicitation informs offerors that Phase II proposals of high technical merit will be further evaluated according to specific commercial criteria. To satisfy these criteria, the offeror must demonstrate such attributes as commercial intent, past success in bringing SBIR technology to commercial application, ability to bring the necessary elements of a commercial venture to bear, and credibility thereof.

Consistent with these criteria, NASA's SBIR commercial survey provides a mechanism to identify commercial applications of NASA SBIR technology and various measures of associated commercial activity. The survey is designed to reveal commercial intent in those cases where the firm has taken significant steps toward a commercial venture at least partially based on NASA SBIR technology, but a resulting product or service has not yet been, or perhaps never will be, sold. Therefore, the offeror's submitting a completed survey form to NASA reflecting efforts to commercially apply technology developed under NASA Phase II awards provides the offeror an excellent opportunity to unequivocally demonstrate commercial intent and commercial capability with respect to NASA SBIR technology. Specifically, submission of the survey form enables NASA to assign credit for commercial information that might not otherwise be included in less specific responses typically provided in proposals to address the commercial potential evaluation factor. The survey form also makes the offeror's commercial applications of technology developed under previous NASA SBIR awards eligible to be the subjects of articles in NASA's *Tech Brief* monthly magazine at no cost to the offeror. *Tech Brief* has a readership of over a half-million individuals per month.

The universe of firms having received NASA Phase II awards over the 1983-94 period numbers about 725 companies. Currently, about 72 percent of the firms have responded, 10 percent have not responded, and NASA has been unable to locate the 18 percent balance of that universe. Accordingly, of those firms that NASA was able to locate, about 87 percent have responded and represent over 78 percent of the 1,444 Phase II's awarded by NASA over the 1983-94 period.

The results show that more than one in four NASA Phase II awards have produced technology that has been incorporated in commercial products and services which have generated revenues in non-government markets. The broad spectrum of the more than 450 associated commercial products and services, and the industrial sectors they represent, demonstrates the pervasive effect of NASA's SBIR program in the national economy. The survey also shows that the degree of strategic alliance partnering among SBIR and non-SBIR firms regarding ventures producing these products and services is significant. Survey results demonstrate significant commercial intent regarding application of NASA SBIR technology in non-government markets. Specifically, for more than one in three Phase IIs awarded by NASA over the 1983-94 period, the technology was either incorporated in products and services generating revenues in non-government markets or significant action was taken to develop a commercial venture at least partially based on the technology.

Among other findings, the survey shows that about 90 percent of all firms winning NASA Phase II awards have received a total of three or fewer NASA Phase II awards. Over the past five years, new entrant firms into the universe of NASA Phase II firms represent about 46 percent of all firms having received NASA Phase II awards for that period. The results thus demonstrate significant opportunity for newcomer firms to enter the NASA SBIR program.

For more information, contact Jack Yadvish at NASA Headquarters, 202/358-1981, *jyadvish@mail.hq.nasa.gov* Please mention you

PHASE I CONTRACTS SELECTED FOR NEGOTIATION

As part of its mission to encourage the development of new and advanced technologies, NASA has selected 290 research proposals for negotiation of Phase I contract awards for its 1999 Small Business Innovation Research (SBIR) program. The total value of the awards is expected to be more than $20 million and will be conducted by 220 firms in 34 states.

In addition to stimulating innovation, the SBIR program aims to increase the number of small businesses, including women-owned and disadvantaged firms, conducting federal research and commercializing the results of federally-funded research.

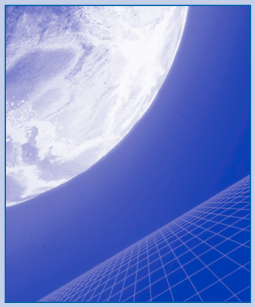
NASA received more than 2260 proposals from small, high-technology businesses located throughout the United States.

NASA's Field Centers reviewed proposals for technical merit, feasibility and relevance to NASA research and technology requirements. The selected firms will be awarded fixed-price contracts worth up to $70,000 to perform a six-month Phase I feasibility study.

Companies that successfully complete the Phase I activities are eligible to compete for Phase II selection the following year. The Phase II award allows for a two-year, fixed-price contract of up to $600,000.

The NASA SBIR Program Management Office is located at the Goddard Space Flight Center in Greenbelt, Maryland, with executive oversight by NASA's Office of Aero-Space Technology. Individual SBIR projects are managed by the NASA Field Centers.

For more information, *visit http://sbir.nasa.gov*



Technology Opportunity Showcase *highlights some unique technologies that NASA has developed and which we believe have strong potential for commercial application. While the descriptions provided here are brief, they should provide enough information to communicate the potential applications of the technology. For more detailed information, contact the person listed. Please mention that you read about it in* Innovation.

Predictive Sensor Algorithm

The John C. Stennis Space Center (SSC) seeks qualified companies for further development and commercialization of a signal analysis process into an application method that increases the response speed of existing sensor technologies. SSC researchers have developed the method, which is now employed as a smart hydrogen detection system.

The system utilizes a signal-processing algorithm to determine, in near real-time, the steady state response of a normally slow sensor. A small microprocessor samples the hydrogen sensor's output at small intervals and dynamically predicts the sensor's response to a step change in temperature. The algorithm has been implemented using both C and BASIC programming languages and resides as firmware in Erasable Programming Read-Only Memory (EPROM).

Potential applications include commercially available hydrogen detection systems, industrial applications including personal safety, and medical-type electronic thermometers, human and veterinary.

A patent has been issued on the technology. Commercialization opportunities may exist through licensing, cooperative development and technical consulting.

For more information, contact the Technology Transfer Office at Stennis Space Center, 601/688-1929. Please mention you read about it in *Innovation.*

Cold Cathodes for Flat-Panel Displays

Goddard Space Flight Center (GSFC) is seeking partners to further develop a flat-panel display using segmented cold cathodes. This technology replaces cathode ray tube (CRT) technology to allow for large displays (greater than 50 inches diagonally) with minimal depth (less than 4 inches) that offer comparable brightness in a simpler design.

Segmented photocathodes are set orthogonally to an array of control grids. The display panel's resolution is defined by the number of control grids (horizontal resolution) and the number of segmented photocathodes (vertical resolution).

The display's input side is illuminated by an electroluminescent panel. Photons created by this panel travel through the input window, then the transparent photocathode gate metallization, and strike the photocathodes. The resulting photoelectrons pass first through the control grids, then through the equipotential mesh grid. The electrons are accelerated as they approach the phosphor screen, striking it at approximately 25 kV and causing the phosphor to glow.

This segmented cold cathode technology can be used for multicolor displays resulting in three times as many control grids as a monochrome display for the same horizontal resolution. Displays made with this segmented cold cathode technology will have one mm^2 pixels. Although this is a lower resolution than with CRT displays, it is a sufficiently small pixel size for large displays.

Using segmented cold cathodes results in a greatly improved flat panel display not achievable by any other existing technology. Researchers estimate that a two-meter by one-meter commercial system could be produced for less than $2,000 in mass production.

Potential applications include large-screen home entertainment systems, public message boards, flight simulations, video games, and network control room displays (e.g., telecommunications, military, computers).

GSFC holds U.S. patent 5,751,109 on this technology. A proof-of-concept monochrome prototype has been completed.

For more information, contact Evette Conwell at Goddard Space Flight Center, 301/286-0561 x60561, 301/286-0301, *evette.conwell@gsfc.nasa.gov* Please mention you read about it in *Innovation.*

Mass Density Sensor

Langley Research Center seeks industry partners to license and cooperatively develop a commercial product using a non-intrusive, low-cost method for determining the weight of textile materials during manufacturing. It measures mass density of filaments, yarns, or optical fibers, as well as coatings or finishes, and resin applied to composite tows.

Novel to this sensor is the direct use of mechanical vibration and the use of an optical technique for sensing tow vibrations. To determine amounts of applied resin, it uses natural mechanical resonance in a moving resin-impregnated yarn, or tow. The moving threadline is under tension and an optical sensor detects vibration at the supported span's center.

Unlike the time-consuming cut and weigh method used today, this new method is non-intrusive and easily operates as part of a continuous process operating at hundreds of feet per minute. Unlike elaborate electronic gauges, the invention is mechanically robust, inexpensive and requires no special safety precautions. U.S. Patent No. 5,694,807 has been issued on this technology.

For more information, contact Gregory S. Manuel at Langley Research Center, 757/864-3864, or *g.s.manuel@larc.nasa.gov* Please mention you read about it in *Innovation.*

NCTN DIRECTORY

Moving Forward

NASA Field Centers

Ames Research Center
Selected technological strengths are Information Technologies, Aerospace Systems, Autonomous Systems for Space Flight, Computational Fluid Dynamics and Aviation Operations.

Carolina Blake
Ames Research Center
Moffett Field, California 94035-1000
650/604-1754
cblake@mail.arc.nasa.gov

Dryden Flight Research Center
Selected technological strengths are Aerodynamics, Aeronautics Flight Testing, Aeropropulsion, Flight Systems, Thermal Testing and Integrated Systems Test and Validation.

Eugene (Lee) Duke
Dryden Flight Research Center
Edwards, California 93523-0273
661/258-3802
lee.duke@dfrc.nasa.gov

Glenn Research Center
Selected technological strengths are Aeropropulsion, Communications, Energy Technology and High Temperature Materials Research, Microgravity Science and Technology and Instrumentation Control Systems.

Larry Viterna
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Cleveland, Ohio 44135
216/433-3484
Larry.A.Viterna@grc.nasa.gov

Goddard Space Flight Center
Selected technological strengths are Earth and Planetary Science Missions, LIDAR, Cryogenic Systems, Tracking, Telemetry, Command, Optics and Sensors/Detectors.

George Alcorn
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Greenbelt, Maryland 20771
301/286-5810
george.e.alcorn.1@gsfc.nasa.gov

Jet Propulsion Laboratory
Selected technological strengths are Deep and Near Space Mission Engineering and Operations, Microspacecraft, Space Communications, Remote and In-Situ Sensing, Microdevices, Robotics, and Autonomous Systems.

Merle McKenzie
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Pasadena, California 91109
818/354-2577
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Johnson Space Center
Selected technological strengths are Life Sciences/Biomedical, Spacecraft Systems, Information Systems, Robotic and Human Space Flight Operations.

Henry (Hank) Davis
Johnson Space Center
Houston, Texas 77058
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henry.l.davis@jsc.nasa.gov

Kennedy Space Center
Selected technological strengths are Emissions and Contamination Monitoring, Sensors, Corrosion Protection and Biosciences.

Gale Allen
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Kennedy Space Center,
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407/867-6226
gale.allen-1@kmail.ksc.nasa.gov

Langley Research Center
Selected technological strengths are Aerodynamics, Flight Systems, Materials, Structures, Sensors, Measurements and Information Sciences.

Sam Morello
Langley Research Center
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757/864-6005
s.a.morello@larc.nasa.gov

Marshall Space Flight Center
Selected technological strengths are Materials, Manufacturing, Nondestructive Evaluation, Biotechnology, Space Propulsion, Controls and Dynamics, Structures and Microgravity Processing.

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Marshall Space Flight Center
Huntsville, Alabama 35812
256/544-4266
sally.little@msfc.nasa.gov

Stennis Space Center
Selected technological strengths are Propulsion Systems, Test/Monitoring, Remote Sensing and Nonintrusive Instrumentation.

Kirk Sharp
Stennis Space Center
Stennis Space Center, Mississippi
39529-6000
228/688-1914
kirk.sharp@ssc.nasa.gov

NASA's Business Facilitators

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

Joseph C. Boeddeker
Ames Technology Commercialization Center
San Jose, CA
408/557-6789

Greg Hinkebein
Mississippi Enterprise for Technology
Stennis Space Center, MS
228/688-3144

Wayne P. Zeman
Lewis Incubator for Technology
Cleveland, OH
216/586-3888, 216/229-9445

Thomas G. Rainey
Florida/NASA Business Incubation Center
Titusville, FL
407/383-5200

Celeste Moore
University of Houston/NASA Technology Center
Houston, TX
713/743-0451

Joanne Randolph
Business Technology Development Center
Huntsville, AL
256/704-6000, ext. 202

Richard C. (Michael) Lewin
Department of Business and Economic Development
Greenbelt, MD
800/541-8549

Van Garner
California State Polytechnic University–Pomona
Pomona, CA
909/869-2276

Martin Kaszubowski
Hampton Roads Technology Incubator
Hampton, VA
757/865-2140

Small Business Programs

Carl Ray
NASA Headquarters
Small Business Innovation Research Program (SBIR/STTR)
202/358-4652
cray@hq. nasa.gov

Paul Mexcur
Goddard Space Flight Center
Small Business Technology Transfer (SBIR/STTR)
301/286-8888
paul.mexcur@pop700.gsfc.nasa.gov

NASA-Sponsored Commercial Technology Organizations

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

Ken Dozier
Far West Technology Transfer Center
University of Southern California
213/743-2353

Dr. William Gasko
Center for Technology Commercialization
508/870-0042

J. Ronald Thornton
Southern Technology Applications Center
University of Florida
352/294-7822

Gary F. Sera
Mid-Continent Technology Transfer Center
Texas A&M University
409/845-8762

Lani S. Hummel
Mid-Atlantic Technology Applications Center
University of Pittsburgh
412/383-2500

Christopher Coburn
Great Lakes Industrial Technology Center
Battelle Memorial Institute
440/734-0094

Joseph P. Allen
National Technology Transfer Center
Wheeling Jesuit University
800/678-6882

Doris Rouse
Research Triangle Institute Technology Applications Team
Research Triangle Park, NC
919/541-6980

NASA ONLINE

Go to the **NASA Commercial Technology Network (NCTN)** on the World Wide Web at ***http://nctn.hq.nasa.gov*** to search NASA technology resources, find commercialization opportunities, and learn about NASA's national network of programs, organizations, and services dedicated to technology transfer and commercialization.

Events

NASA Langley Research Center will host a Research, Development and Technology Conference - "Business Funding Opportunities with the National Aeronautics and Space Administration and the National Institute of Standards and Technology" on April 6, 2000 at the Radisson Hotel in Hampton, Virginia. Organizers of the event are the Office of Innovative Technology, Office of the Secretary of Technology, Commonwealth of Virginia.

The conference will focus on the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer Programs (STTR) of NASA and the Advanced Technology Program of the National Institute of Standards and Technology.

The presenters will provide an overview of these programs, information on how to compete for the funding, examples of some of the research opportunities, and a talk by a successful bidder for SBIR funds. For further information about the conference contact Dr. K.C. Das, 804-371-5599, email *kcdas.dit@state.va.us* There will be a $30 registration fee. Attendance is limited.

The ***National SBIR Conference*** to be held in Washington, D.C. in Spring 2000 is anticipated to be the largest federally-sponsored conference focused on helping small, high-technology companies access these funds. A unique feature of the conference is the one-on-one meetings with R&D program managers from the 11 federal agencies responsible for 98% of all the federal R&D spending. Major corporations will also be having one-on-ones to seek innovative technologies. Seminars and other sessions with government and private experts are scheduled. The registration fee covers all conference sessions, documents, and meals. For more information, contact the conference hotline: 561-588-8825 or e-mail *teddy@seeport.com*

The ***NASA Stennis Space Center SBIR program*** will host several NASA Proposal Writing Seminars. The dates for the seminars are scheduled for March 23, 24, 30, and 31 and April 4, 7, 10 and 18. Learn what it takes to write a winning SBIR and STTR proposal. For information on how to register, contact Ms. Staci Kramer at 228/688-1929 or e-mail *technology@ssc.nasa.gov*

Turning Goals Into Reality (TGIR) Conference is an opportunity for NASA and its industry partners to acknowledge major technological advances in aeronautics and space access. The two-day event, to be held May 18-19 at NASA's Marshall Space Flight Center in Huntsville, Alabama, will include keynote addresses by top-level NASA managers and other government leaders, awards for technology development leaders and opportunities for potential partners to discuss the groundbreaking work that lies ahead. Technology status briefings, demonstrations and tours of the Marshall Center are also part of the conference program. Attendance is limited. Exhibitors are welcome. For more information, access *http://tgir.msfc.nasa.gov*

National Aeronautics and
Space Administration

Office of Aero-Space Technology
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