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# innovation

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## Working Together for NASA

Online Tool Evaluates Seasonal Forecasts  
Technology Opens Door to the Space Frontier  
New Camera Benefits Astronomy and Medicine



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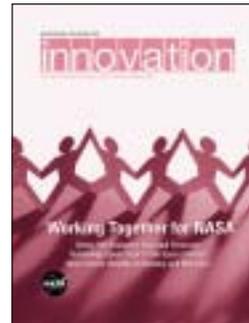
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#### About the Cover:

NTTC is one part of the NASA Commercial Technology Network.

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## Commercial Development Mission Update

Date	Flight	Payload	Sponsor/Coordinator
TBD	9A	Plant Generic Bioprocessing Apparatus (PGBA) Commercial Generic Bioprocessing Apparatus (CGBA) Zeolite Crystal Growth (ZCG) samples	Bioserve Space Technologies Bioserve Space Technologies Center for Advanced Microgravity Processing (CAMMP)
TBD	11A	Zeolite Crystal Growth (ZCG) samples	Center for Advanced Microgravity Materials Processing (CAMMP)

# Welcome to innovation

## “Let’s Make a Deal” for NASA

By Joseph P. Allen

*President, Robert C. Byrd National Technology Transfer Center*

During a recent speech at Syracuse University, NASA Administrator Sean O’Keefe discussed the space agency’s mandate to improve life here, to extend life to there and to find life beyond.

“From medical devices to better tires, many of the products we use and experience every day have their origins in NASA technology,” Administrator O’Keefe said. “The American taxpayers’ investment in NASA pays off every day in spin-off technology.”

The Robert C. Byrd National Technology Transfer Center (NTTC) has enjoyed a relationship with NASA for more than a decade, and, as president of NTTC, I appreciate what NASA has to offer to improve life here on Earth. There is little doubt the agency known for landing man on the moon, the space shuttle and the International Space Station is home to world-class research with worlds of potential.

Indeed, the spin-off technology—turning a technology developed for the space program into a technology to benefit life on Earth—to which Administrator O’Keefe is referring has made an impact. Products such as cordless tools, athletic equipment and medical equipment are just a few examples of products today that have their roots in the space program.

“NASA’s job is to develop the technologies of the future to meet its mission and then to turn that technology loose so that government and America’s entrepreneurs can turn them into products for the greater good,” Administrator O’Keefe said as he continued his speech.

Enter the NASA Commercial Technology Network (NCTN). The NCTN is comprised of the commercial technology offices of all 10 NASA Centers, the commercial technology division of NASA Headquarters, the nine NASA-sponsored incubators, Research Triangle Institute, NASA/MSU TechLink Center, Tech Briefs, the six Regional Technology Transfer Centers and NTTC. Together, these individual entities provide NASA with technology development partners, technology commercialization partners and expertise.

Facilitating partnerships between the federal government and US industry in an effort to turn technologies into products—spin-off technologies—for the greater good is what the NCTN and NTTC are all about.

NTTC was established at Wheeling Jesuit University in 1989 by the US Congress to strengthen American industry by providing access to more than \$70 billion worth of federally funded research. Today, it is a full-service technology management organization, providing access to federal technology information; technology commercialization training; technology evaluation, marketing and commercialization services; assistance in finding strategic business partners; and electronic business development services.

Through a cooperative agreement with NASA, NTTC provides value-added services designed to ultimately turn NASA research into products by facilitating technology commercialization deals, such as Space Act Agreements. From professional development offerings to technology evaluation and marketing services, NTTC has long worked with NASA to make the most of its commercialization resources.

Consider that NTTC facilitated 13 commercialization partnerships with industry, as well as conducted evaluations on more than 300 technologies for commercial and market potential in FY 2001. NTTC also interacted with more than 2,000 companies, resulting in more than 275 leads being sent to NASA Centers. During the same time period, more NASA personnel than ever participated in NTTC training courses. Add to that the NTTC marketing efforts, including the use of its Web site and [www.nasatechnology.com](http://www.nasatechnology.com), developed and maintained in-house by NTTC to showcase NASA technology and highlight related partnerships opportunities, and you have a full-service provider dedicated to the aerospace agency and its mission.

Administrator O’Keefe touched on the importance of synergy and collaboration in his speech. Today, for example, NTTC is marketing NASA technologies to meet the technology needs of America’s first responder community through the NTTC Emergency Response Technology Program (ERTP).

The ERTP is designed to determine the technology needs of the first responder and either identify products that are already commercially available or work with various federal laboratories, universities and private industry to find potential solutions to the needs.

NTTC meets NASA’s needs because it creates the spin-off technology that can improve life here. It also meets the need of the first responder who puts his or her life on the line every day for our safety.

Administrator O’Keefe added, “So, how do we get to that impressive picture of the future? Part of the answer is by executing NASA’s mission to understand and protect our home planet, to explore the universe and search for life, to inspire the next generation of explorers... as only NASA can.”

A little help from NTTC can’t hurt. □

## Working Together for NASA

The goal of the NASA Commercial Technology Network (NCTN) is to bring NASA-developed technologies to commercialization to turn aerospace program research into beneficial products for everyday use. The Robert C. Byrd National Technology Transfer Center (NTTC) has a pivotal role in helping NASA reach that goal.

The NCTN is comprised of the commercial technology offices of all 10 NASA Centers, the commercial technology division of NASA Headquarters, the nine NASA-sponsored incubators, Research Triangle Institute, NASA/MSU TechLink Center, Tech Briefs, the six Regional Technology Transfer Centers and NTTC. Together, these individual entities provide NASA with technology development partners, technology commercialization partners and expertise.

“The success that NTTC has had in NASA commercialization efforts is based on a close relationship with the NASA training and marketing committees, and the commercial technology offices at the field centers,” said NTTC president Joseph P. Allen. “These relationships provide a solid foundation for the commercialization partnerships that we facilitate.”

NTTC provides a number of value-added services to NASA, including its market and technology assessment, technology marketing, leads qualification and training services, and is a key player in NASA’s commercialization efforts.

NTTC’s market and technology assessment services are designed to determine which NASA technologies have commercial potential. NTTC assesses the merit and novelty of a technology, identifies and compares competing technologies, evaluates markets to recognize opportunities and identifies potential partnership organizations.

“NTTC provides NASA with third-party, unbiased evaluations of the commercial potential of its technologies,” Allen said. “This is a very valuable service that goes a long way in the commercialization process. It allows NASA to focus its efforts on the technologies that provide the best opportunity and return on investment.”

NTTC’s marketing efforts, including partnership identification and development, are designed to ultimately find qualified companies interested in NASA technologies available for commercialization. NTTC markets the technologies in a number of ways, including participating in and speaking at various conferences and trade shows, directing marketing techniques, visiting companies and showcasing the technologies and their benefits on [www.nttc.edu](http://www.nttc.edu) and [www.nasatechnology.com](http://www.nasatechnology.com)—a Web site created and maintained by NTTC.

“NASA research has so much potential, and it is NTTC’s responsibility to make US industry aware of that potential,” said Jerry Miller, NTTC’s vice president of marketing. “It is our job to facilitate the partnerships that make commercialization happen.”

NTTC’s marketing team works closely with the NASA marketing team to develop and utilize a marketing strategy for NASA’s commercial technology. NTTC works to support several centers at technology events on an annual basis, including Sensors Expo, National Manufacturing Week, Society for the Advancement of Material and Process Engineering, and The

Institute of Electrical and Electronics Engineers. NTTC’s responsibilities in this area include exhibit setup, facilitating presentations, pre-show marketing and relationship development efforts to generate ongoing interest in partnership opportunities with NASA.

Another vehicle NTTC uses to market NASA technologies is its own Web site ([www.nttc.edu](http://www.nttc.edu)), which is home to TechOps, a focused effort to showcase and commercialize state-of-the-art NASA technologies. TechOps provides detailed information on available technologies that have been evaluated by NTTC and have strong commercial potential. In some cases, TechOps provides a video or animation of the technology that provides an even better understanding of how the technology works and its benefits.

“Technology marketing is all about creating partnerships that are essential to making commercialization happen. TechOps is one venue that helps create these

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NTTC’s marketing team works closely with the NASA marketing team to develop and utilize a marketing strategy for NASA’s commercial technology.

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partnerships,” Miller said.

Looking for yet another way to tap into the latest cutting-edge technology from NASA? Visitors to [www.nasatechnology.com](http://www.nasatechnology.com) have the opportunity to view NASA's hottest technologies. NTTC worked with NASA Centers to identify their most commercially viable technologies and compiled these innovative technologies onto one site. In addition, SPINOFF, an invaluable product resource, is available on the Web site.

NTTC also is responsible for helping the NASA Centers determine the best partner for technology commercialization. In order to narrow down the field of potential commercial partners, NTTC utilizes a leads qualification system. The system includes criteria for partnership set forth by each field center, as well as additional business data gathered by NTTC.

“We want to bring to NASA companies that have been pre-qualified as legitimate companies with a serious interest in a NASA technology,” Miller said. “We do not want to inundate NASA with information on every company that expresses an interest. We provide them with real leads and real opportunity.”

In order to become a qualified lead, Miller said, a company is asked a series of questions based on criteria set forth by each of the 10 NASA Centers. This infor-

mation, along with other pertinent data, is gathered by engaging in extensive conversations with the company. NTTC collects additional information such as company expertise, strength in the market, commercialization experience and financial viability through innovative research techniques that further qualify the company.

Once this information is collected and all criteria are met, the company is then considered a qualified lead and is entered into NTTC's Leads Tracking System and sent to the appropriate field center. An e-mail summarizing the information collected on the company is sent to the field center point of contact to alert them that a qualified lead has been entered and to facilitate discussions and eventual partnership negotiations. As a result of NTTC's efforts, more than 15 deals have been consummated over the past 24 months.

For example, Jet Propulsion Laboratory (JPL) recently asked NTTC to perform a market and technology evaluation of a global positioning satellite technology. NTTC determined that the technology had strong commercial potential and identified a targeted list of potential licensing partners. Included in this group was a venture capital firm that was working with a start-up business with a use for this technology. In addition, a license has been executed for use of the



NTTC's marketing team supported NASA's commercial technology efforts at National Manufacturing Week (NDES), held in Chicago, Ill.

GPS technology in precision agriculture.

“This is an example of what NTTC provides NASA in its efforts to support commercialization of its technologies,” Allen said. “It is all about adding value. NTTC evaluates, markets, facilitates and trains. We are truly a full-service technology management organization.”

Complementing its wide range of services is NTTC training, which enhances the technology management and e-commerce skills of its clients. NTTC provides professional development services for members of the NASA commercial technology teams. NTTC training courses are developed in conjunction with subject matter experts who have extensive background in industry, university and/or federal laboratories.

In 2001, more than 1,000 people participated in NTTC training courses.

“We offer both synchronous and asynchronous learning activities over the Web, complemented by facilitator-led classroom courses,” said Tracee Joltes, NTTC vice president of training. “These delivery systems, combined with the knowledge of our experts, help our clients to foster professional growth through learning opportunities and ensure that they receive the best technology commercialization training possible.”

There have been successes in the past, but NTTC is

also working to build on its relationships with individual field centers. NTTC has joined forces with NASA Glenn Research Center’s Commercial Technology Office and its flagship technology program, the Ultra-Efficient Engine Technology Program, to create a method for examining NASA’s early-stage research and development. The goal of this effort is to find non-aerospace applications for early-stage NASA research.

NTTC’s Emergency Response Technology Program (ERTP) is also working with NASA to identify and market technologies to meet the needs of America’s first responder community. The goal of the ERTP is to identify technology needs of the first responder and either identify products that are already commercially available or work with federal laboratories, universities and private industry to find solutions to the needs. If NASA has the solution, NTTC will find it, and ERTP will help get it into the hands of the first responders.

“Developing a technology that meets the needs of the first responders who battle for their lives every day protecting America... talk about a return on investment,” Allen said. □

For more information, visit [www.nttc.edu](http://www.nttc.edu). Please mention you read about it in **Innovation**.



Oscar the Robot helps attract visitors to NASA’s booth at National Manufacturing Week (NDES).

## Seeing the “Big Picture” Better

NASA’s unique image-compression technology developed for collection, transmission and distribution of space imagery to scientists at remote locations now can be used to enhance the quality of printing for Internet, Web-TV and medical imaging.

Six D, a digital media development firm known for its support of *Fortune* 2000 companies’ marketing efforts, has recently licensed this NASA-developed technology known as DCTune. DCTune is software that adjusts the compression of a still image so it has optimal quality and minimum file size with no perceptible loss of image quality. This technology builds on JPEG (Joint Photographic Experts Group), the current international standard for still image compression, calculating the matrix that will produce minimum file size with a visually perfect image.

“DCTune works by replacing the human viewer with a computer model viewer,” said the developer of the software, Andrew Watson of NASA Ames Research Center, Moffett Field, CA. “It ‘looks’ at the image just like a human does—seeing the same errors and missing the same subtleties,” Watson explained.

Similar to the process in a human brain, DCTune allows the computer to adjust each of the 64 detail levels it sees until they are as low as possible, but yielding no

visible errors. “It is an interesting application of human technology,” Watson added. “In fact, this is a computer model of part of the human brain.”

Working closely with NASA’s Far West Regional Technology Transfer Center (RTTC), the Honolulu-based Six D, Inc. received support in developing its commercialization strategy required to license the NASA patent. This included defining technology modifications required to refine DCTune for commercial use, as well as an extensive analysis of potential market segments.

“NASA has offered us a way to add substantial technologies to our inventory at a fraction of what it would cost to develop them,” said Kelly O’Connor, Six D’s chief operating officer. “This gives us a significant offering for those looking to reduce bandwidth and storage requirements worldwide.”

“Both NASA and private industry benefit when we partner for commercialization,” noted David Lackner, technology commercialization manager at Ames. “In Six D, we have a firm that is in a prime position to take NASA R&D to market.” □

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For more information, contact David Lackner at NASA Ames Research Center, ☎ 654/604-5761, 📞 650/604-1592, ✉ [dlackner@mail.arc.nasa.gov](mailto:dlackner@mail.arc.nasa.gov). Please mention you read about it in **Innovation**.

## Scientist Discusses Commercial Use of Remote Sensing

Satellite technologies that could lead to more effective monitoring of crops, natural resources and disease outbreaks were the focus of the Space-Based Tools for Valley Economic Growth Conference.

Attendees heard David Peterson, chief of NASA Ames Research Center’s Earth Sciences division, speak about NASA’s geospatial technologies that have applications for agriculture and natural resource assessment.

“NASA’s remote-sensing data and models of the Earth system are being used to understand the entire Earth system and predict its response to natural and human-induced change,” said Peterson. “These same tools can be applied to many practical applications, from weather prediction to disasters, to agriculture and resources. I tried to illustrate how space-based tools, including commercial ones, can be used in a meaningful way by the end-user community.”

In addition to the introduction of NASA’s latest developments, the audience also learned more about the licensing and commercialization of space innovations.

“NASA technologies and knowledge are valuable resources often overlooked by many traditional industries,” said Ken Dozier, executive director of the Far West Regional Technology Transfer Center. “New high-velocity markets demand that competitive firms examine all options, and, hopefully, this event will begin a series of dialogs that will lead to economic development in the Merced (California) community.” □

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For more information, contact Robin Orans at NASA Ames Research Center, ☎ 650/604-5875, 📞 650/604-1592, ✉ [rorans@mail.arc.nasa.gov](mailto:rorans@mail.arc.nasa.gov), or visit the Ames Earth Science Web site at <http://geo.arc.nasa.gov/sge/env.html>. Please mention you read about it in **Innovation**.

## Inventions of the Year Selected

A miniature pump designed to help your heart beat and a device that ensures the safety of the International Space Station and its crew have received NASA's Commercial and Government Invention of the Year awards.

Receiving NASA's Commercial Invention of the Year is a miniature ventricular-assist device (VAD). Initially called the NASA/DeBakey heart pump, it is based in part on technology used in space shuttle fuel pumps. It is intended as a long-term "bridge" to a heart transplant or as a more permanent device to help patients toward recovery and a more normal life.

The concept for the pump began with talks between Dr. Michael DeBakey of Houston's Baylor College of Medicine and one of his heart transplant patients, NASA engineer David Saucier. Saucier, who worked at NASA Johnson Space Center in Houston, knew first-hand the urgency heart-failure patients feel waiting for a donor heart. He also knew space shuttle technology.

Six months after his 1984 heart transplant, Saucier was back at work and arranged for fellow NASA engineers James Akkerman, Bernard Rosenbaum, Gregory Aber and Richard Bozeman to meet with Dr. DeBakey, Dr. George Noon and other Baylor staff. The result was a remarkable battery-operated pump—approximately three inches long, one inch in diameter and weighing less than four ounces—that seems to be an answer to the decades-long quest to develop an implantable VAD.

NASA, in keeping with its mission of transferring space-based technology to the private sector, granted exclusive rights to MicroMed Technology Inc., Houston,

in 1996 after intense competition. In European trials, the MicroMed/DeBakey VAD was implanted in 115 persons without any incidence of device failure. US trials involve 178 implants, of which 21 have already been successfully performed.

The NASA Government Invention of the Year goes to a team from Glenn Research Center in Cleveland. The team invented a hollow cathode assembly that is the primary component of the International Space Station's plasma contactor system. This mission-critical

system protects the station and its crew from the dangers associated with electrical charges.

As the Space Station floats through space in low-Earth orbit, the surface of the structure builds up a static high-voltage charge. The plasma contactor system safely grounds the station from this high voltage, protecting it from arcing, which could severely damage its surface. This device is unique in that it reduces the static charge in a self-regulating manner to levels safe enough for astronaut space walks.

The team of Michael Patterson, Timothy Verhey and George Soulas developed the technology from a laboratory device to flight

qualified hardware and manufactured the space flight hardware for the orbiting research platform. The team's efforts also resulted in increasing hollow cathodes' lifetimes from 500 hours to 28,000 hours, enabling their use on ion thrusters, a key technology used for NASA spacecraft missions. □

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For more information, contact Michael Braukus at NASA Headquarters, ☎ 202/358-1979, ✉ [mbraukus@mail.hq.nasa.gov](mailto:mbraukus@mail.hq.nasa.gov). Please mention you read about it in **Innovation**.

# Multimedia Units Tell NASA Technology Transfer Story

Interactive multimedia displays are being installed at high-profile locations around Alabama to share stories of technologies born in the space program that change life on Earth.

The standalone stainless steel units feature touch-screen menus and graphic presentations that take viewers on a technology transfer journey that began during the Apollo moon mission days and continues to evolve today.

The Technology Transfer Department at NASA Marshall Space Flight Center in Huntsville, AL has placed the first units. They are at the Huntsville International Airport, Madison Square Mall in Huntsville, the Birmingham International Airport and the Marshall Center complex, Building 4200.

“This is one way we take our message to different audiences,” said Vernotto McMillan, deputy manager of the Technology Transfer Department at Marshall. “We’re trying to reach everyone from children to senior adults,

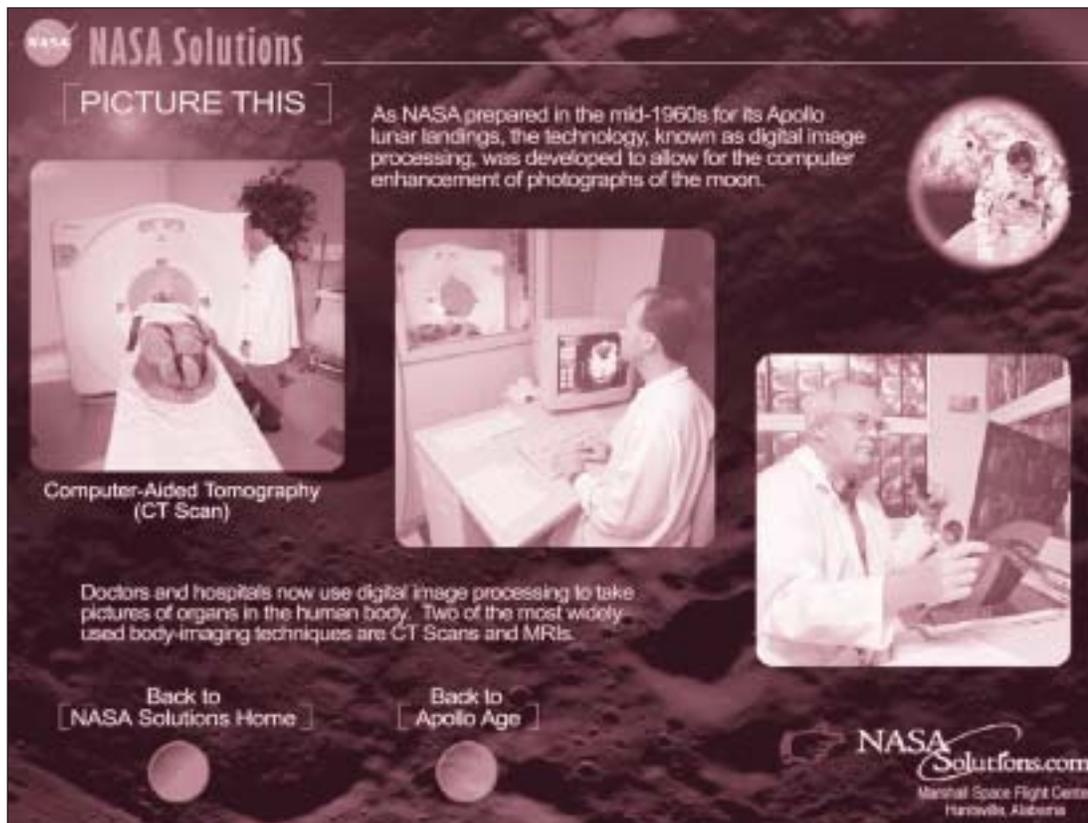
from business travelers to vacationers. The ultimate goal is to give American taxpayers the knowledge of how their space program is benefiting their everyday lives.”

A touch screen dealing with the Apollo years recalls the development of digital imaging processing. It led to the widely used body-imaging techniques of today, including computer-aided tomography (CAT scan) and magnetic resonance imaging (MRI).

Astronauts exploring the moon needed a durable, long-lasting portable drill to gather core samples sometimes as deep as 10 feet (3.3 meters). The interactive display explains how the development of those tools led to the millions of cordless rechargeable products used today.

Touch the screen to bring up the story of how insulating products from human space flight are now being used to keep NASCAR drivers cooler during their long races. The composite flexible blan-

*Continued on page 10*



Because a picture is worth a thousand words, multimedia displays tell NASA's successes in sight and sound. The Apollo years saw the development of digital imaging processing which led to the widely used body-imaging techniques of today: computer-aided tomography (CAT Scan) and magnetic resonance imaging (MRI).

### Multimedia

*Continued from page 9*

ket insulation material significantly lowers temperatures inside vehicles, reducing driver fatigue while increasing racing safety.

Another touch of the screen brings up the story of video image stabilization and registration technology, or VISAR. This computer-based system invented by two Marshall Center scientists dramatically improves video by stabilizing images, making them sharper and more legible. The FBI used it during the investigation of the 1996 bombings of the Atlanta Olympics. Invaluable details were caught on surveillance films. Other law-enforcement agencies have since used the technology to help track and find criminals in several dozen cases across the US. This same technology will soon be incorporated into consumer electronics.

Touching another part of the display screen brings up the story of light-emitting diodes. Originally used for plant experiments on the space shuttle, this specialized type of light source is now used in important experiments which should lead to the treatment of certain forms of cancer and is being adapted to help with hard-to-heal wounds, including ulcers and severe burns.

“These examples are just part of a much larger effort to bring the amazing advances of space technology to our world,” McMillan said. “The technologies we need to reach the stars are truly the engines that drive America’s future, and we expect many more breakthroughs in the days ahead.”

Exodus Technology Corporation of Huntsville, in conjunction with Getronics Government Solutions of Herndon, VA, along with KAE Corporation and Enhanced Realities, both of Huntsville, developed the multimedia display units through a technology transfer contract. Future plans may include additional units being installed throughout the United States. □

For more information, contact Helen Stinson at ☎ 256/544-7239, ✉ [helen.stinson@msfc.nasa.gov](mailto:helen.stinson@msfc.nasa.gov). Please mention you read about it in

**Innovation.**

The Multimedia Display Team, bringing NASA's success stories to a location near you. From left to right: Tom Knight, Cortez III; Vernotto C. McMillan, MSFC Technology Transfer Deputy Director; Tom Hodges, Enhanced Realities; Dawn M. Graham, Getronics Government Solutions; Kathy Jordan-Pettus, KAE Corporation; Constance James, Getronics Government Solutions; Kevin Kunze, Enhanced Realities; and Jacqueline Reid, Exodus Technologies. Not pictured, Helen Stinson, Technology Transfer Small Business Manager.



## JPL Develops New Portable Fuel Cell Technology

NASA researchers have reached an important milestone in developing a portable energy source that may someday make a better battery.

A team of fuel cell experts at NASA Jet Propulsion Laboratory in Pasadena, CA has taken what have been traditionally large, bulky stacks of layered fuel cells and altered their design dramatically. They have designed a compact, flat fuel cell, reducing its weight substantially. The result is a portable fuel cell technology that may someday operate small, portable electronic devices, such as cell phones, laptops, handheld organizers and camcorders, for hours and even days at a time without recharging.

"This is a significant advance in fuel cell development because, by going small, you make the fuel cell portable and viable for use as a power source to operate small appliances that require long operating time, such as a laptop," said Dr. S.R. Narayanan, fuel cell technical team lead at JPL.

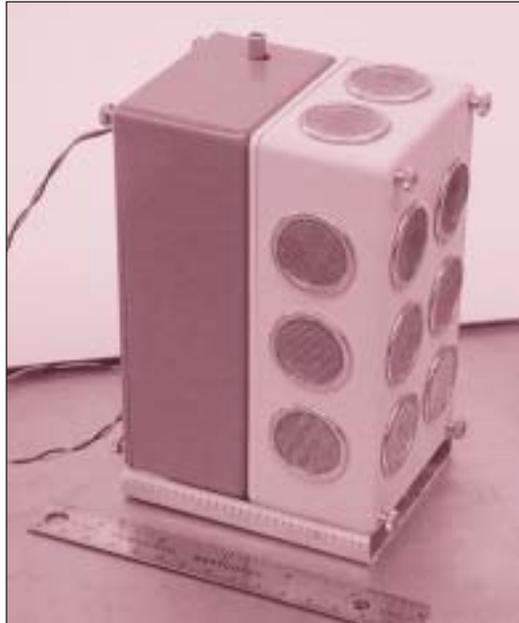
Work on the portable fuel cell technology is sponsored by a public company, TechSys, Inc. of Florham Park, NJ, through a technology affiliates agreement with JPL. By becoming a technology affiliate member, TechSys, Inc. gained access to JPL engineers and technologists who specialize in fuel cell technology development.

"Instead of recharging your laptop every two hours, imagine being able to use it for 10 hours at a time," said Narayanan. Unlike batteries, these fuel cells can be recharged almost instantaneously by refueling with liquid methanol. Typical batteries contain toxic materials and must be disposed of properly.

A fuel cell works on the same principle as a battery but is continually fed with fuel. In this new power source, methanol is put in on one side of the unit, while air circulates on the other side. Both are circulated past electrodes and converted to electricity. This process produces no toxic emissions; carbon dioxide and water are the only byproducts. Methanol, better known as methyl alcohol, is a common, inexpensive chemical.

Existing fuel cells typically operate at high temperatures, require bulky thermal insulation and use hydrogen as their energy source. Much of their weight and size is due to the bipolar plates needed to connect several cells to form a stack. JPL researchers have eliminated bipolar plates and created what is called a monopolar pack, which is flat, with the cells linked by electrical interconnects.

To demonstrate the feasibility of the portable fuel cell technology, JPL developed a five-watt portable



A team of fuel cell experts at Jet Propulsion Laboratory has designed a compact, flat fuel cell. The result is a portable fuel cell technology that may someday operate small, portable electronic devices, such as cell phones, laptops, handheld organizers and camcorders for hours at a time without recharging batteries.

power unit. The power source uses the new lightweight monopolar flat pack technology and is roughly the size of two paperback books standing tall, back-to-back. It operates efficiently at ambient temperature without a fan, unlike conventional designs.

JPL engineers rigged a cell phone to this power unit and placed several phone calls as a demonstration. They estimate that the five watts could simultaneously power five cell phones.

Now that the concept of making a portable, flat stack has been demonstrated, the next phase underway at JPL is to make it smaller, more robust and user-friendly.

JPL's fuel cell group has been working on direct methanol fuel cells since the early 1990s and is credited with inventing the technology, largely under funding from the US Defense Advanced Research Projects Agency. The creation of the portable power source builds on that work and experience.

TechSys, Inc. has the rights to an exclusive license on the development of this micro-direct methanol fuel cell technology from JPL's parent institution, the California Institute of Technology, also in Pasadena. TechSys, Inc. intends to commercialize the JPL portable fuel cell technology for civil and defense applications. □

For more information, contact Dr. S.R. Narayanan at the Jet Propulsion Laboratory, ☎ 818/354-0013. Please mention you read about it in **Innovation**.

## New Partnerships Set to Reshape NASA Science Modeling

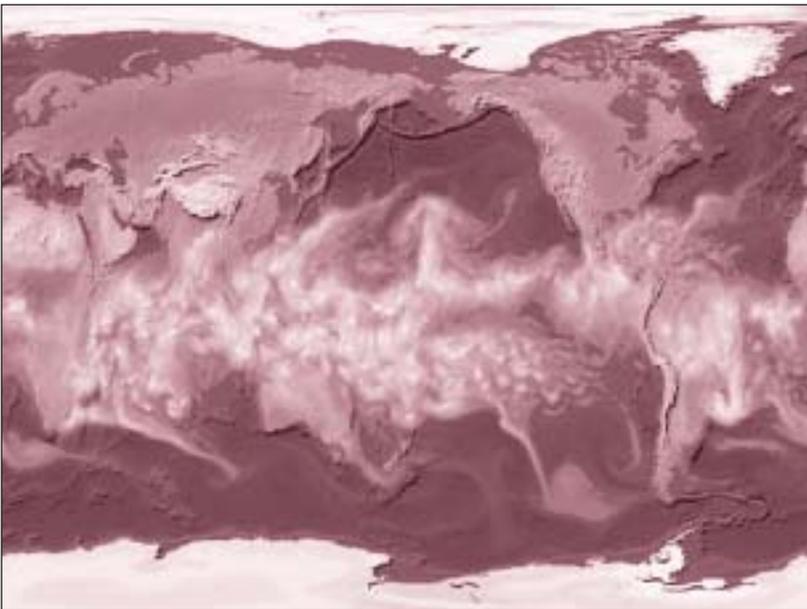
NASA is joining with leading university and government researchers to develop software frameworks that will enable more realistic simulations of natural phenomena and interpretation of vast quantities of observational data on high-end computers.

Over the next three years, the agency will pay out \$22.8 million to 11 investigation teams, attacking challenges as diverse as:

- making it possible for many climate- and weather-modeling groups to share and reuse each other's software,
- creating multi-year earthquake forecasts,
- predicting space weather using real-time observations, and
- uncovering the workings of gamma-ray bursts.

"These agreements represent a major investment in development of the software infrastructure that is needed to support high-end computing applications in the Earth and space sciences," said Dr. Richard Rood, acting chief, Earth and Space Data Computing division at NASA Goddard Space Flight Center in Greenbelt, MD. "The applications are at the forefront of scientific discovery through computational experimentation and also sit at the foundation of the software codes used to assess climate change."

The Community Climate System Model-2 (CCSM-2) couples land, atmosphere, ocean and sea ice models. This visualization shows precipitable water as modeled by CCSM-2.



For instance, teams led by the National Center for Atmospheric Research, the Massachusetts Institute of Technology and NASA Goddard will be building a prototype software infrastructure that will make it possible for the nation's most widely used climate and weather models and systems for assimilating the latest observational data to readily operate together.

The partners expect this "Earth System Modeling Framework" to reshape the national modeling community by vastly reducing the effort researchers must expend on developing software and by initiating an unprecedented level of cooperation among leading Earth scientists.

The Earth System Modeling Framework will handle all communications among atmosphere, land, ocean and other models, and will enable them to run on a variety of supercomputer architectures without time-consuming reprogramming. The framework will improve the fidelity and predictive capability of the models by making it much simpler for researchers to swap and compare alternative scientific approaches from many different sources.

"This multi-agency activity is a key part of NASA's contribution to focusing the country's climate- and weather-modeling activities on problems of national priority," Rood said.

Applications designed for early adoption of the Earth System Modeling Framework will come from two additional investigations. A team headed by the University of California, Los Angeles will enhance coupled model simulations of the El Niño-Southern Oscillation and its far-flung effects on climate. Another team led by Goddard researchers will increase climate simulation accuracy by creating and coupling a land-surface model/data assimilation system that captures the Earth's water and energy cycles in near real time.

NASA Jet Propulsion Laboratory leads the earthquake forecasting team, whose software will ingest data from Global Positioning System and Synthetic Aperture Radar satellites into simulations of Southern California's crustal fault interactions.

Goddard directs a second investigation focused on the western United States. The group will heighten the realism of models predicting how invasive plant species spread in national parks and wilderness areas.

The University of Michigan heads an investigation

*Continued on page 14*

# Online Tool Evaluates Seasonal Forecasts

A soon-to-be-released online tool, developed through NASA funding, provides *Consumer Reports*-type evaluations of seasonal forecasts for water, land and agricultural managers. By helping users determine what forecasts are right for their needs, this tool could help users make multi-million-dollar decisions.

Seasonal forecasts predict whether temperatures and precipitation in an area will be above or below average for an upcoming season. This tool tells users how accurate these predictions have been in the past.

If understood and used properly, long-range forecasts can greatly aid in the management of water, fires, cattle, agriculture, energy and more.

"There is so much misinterpretation concerning climate forecasts in general," said Holly Hartmann, a University of Arizona hydrologist and lead author of a paper that was the cover story in the May issue of the *Bulletin of the American Meteorological Society*. "Part of our tool tries to make sure that forecasts are easy to interpret and that people can reliably interpret them."

When millions of dollars and lives are at stake, resource managers have been tentative about taking advantage of sophisticated climate forecasts available on the Web. By explaining and evaluating these forecasts, the new tool helps decision-makers utilize them regardless of their training.

"One of the major reasons why natural resource managers don't use climate forecasts is because they don't know how good they are," said Tom Pagano, a University of Arizona researcher and co-author of the paper.

Seasonal forecasts are made through the use of data from satellites, computer models and ocean buoys. Scientists predict the climate of future seasons based on interactions between atmospheric pressures and slowly varying ocean temperatures. They then compare these assessments with historical weather patterns.

The tool allows users to customize evaluations to consider the lead times, seasons and locations most relevant to each resource manager's specific needs.

For example, the high likelihood of a wet winter gives water reservoir managers in the southwest more confidence when they make decisions to let water out of a reservoir in the fall. A mistake can lead to water shortages, as well as millions of dollars spent pumping groundwater.

Ranchers, on the other hand, use seasonal forecasts to make predictions concerning winter and summer climates that affect grass growth. By having an idea of



the probability of unfavorable conditions, they can stock up on hay ahead of time.

Also, wildfire managers may use seasonal forecasts of temperatures and rainfall early in the year to budget their resources for the rest of the year, make decisions about fire risks, determine when might be a good time to conduct prescribed burns and rehabilitate previously burned areas.

The online tool is currently set up to assess the seasonal outlooks regularly issued by the National Weather Service's (NWS) Climate Prediction Center (CPC), which serves as the government's official forecaster.

"Since seasonal forecasts aren't as consistently reliable as short-term weather forecasts, it's important that we communicate their performance characteristics in a way that users can understand and exploit," said Robert Livezey, chief of the NWS Office of Climate, Weather and Water Services, and a former senior scientist at the CPC. "This work makes substantial progress in this regard for specific users."

Funding for the project was provided through grants from NASA's Earth Observing System and the National Oceanic and Atmospheric Administration.

In the latter stages of development, the site will be made public by late summer through the University of Arizona's Hydrological Data and Information System (HyDIS) Web site at <http://hydys.hwr.arizona.edu/> □

Roosevelt Dam of the Salt River Project (SRP) is the major water supplier for Phoenix, AZ. In August 1997, a seasonal forecast predicted an El Niño, which often leads to a wet winter in the southwest. In anticipation of high flows, SRP released water from their reservoirs and saved over a million dollars through the use of the seasonal climate forecast. They risked losing \$5 to \$6 million if the forecast had proved incorrect. Photo credit: Salt River Project.

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For more information, contact Thomas Pagano, NWCC-NRCS-USDA, 101 SW Main, Suite 1600, Portland, OR 97204, ☎ 503/414-3010, ✉ [tpagano@wcc.nrcs.usda.gov](mailto:tpagano@wcc.nrcs.usda.gov) or Holly Hartmann at the University of Arizona, ☎ 520/626-8523, ✉ [hollyh@hwr.arizona.edu](mailto:hollyh@hwr.arizona.edu). Please mention you read about it in **Innovation**.

## New Partnerships

*Continued from page 12*

constructing a Space Weather Modeling Framework. Solar and interplanetary satellite observations will drive predictions from linked models that span the distance from the sun's outer atmosphere to the Earth's upper atmosphere.

Frameworks for simulating astrophysical phenomena will come from teams based at Ernest Orlando Lawrence Berkeley National Laboratory, who will study star formation and the behavior of matter in microgravity environments, and the University of Illinois at Urbana-Champaign, who will grapple with understanding observational data from gamma-ray bursts—phenomena believed to be the most powerful explosions in the universe.

Encompassing the entire cosmos, a team led by the California Institute of Technology will deploy an on-

demand image mosaic service for the National Virtual Observatory in an effort to meld astronomical observations stored in databases across the United States.

All payments to the teams are tied to the successful achievement of negotiated milestones. Funding for the partnerships comes from the Earth Science Technology Office's Computational Technologies Project, which is dedicated to helping solve agency mission problems across the Earth, space and life sciences. The 11 investigations will transfer the new capabilities to customers at NASA Centers and in the wider science community. □

For more information, contact Jarrett Cohen at Goddard Space Flight Center, ☎ 301/286-2744, ✉ [jcohen@pop900.gsfc.nasa.gov](mailto:jcohen@pop900.gsfc.nasa.gov). More information about the Computational Technologies Project is available at <http://ct.gsfc.nasa.gov>. Please mention you read about it in **Innovation**.

## NASA Video Innovation Wins Major Award

The team responsible for NASA software technology proven to be invaluable for law enforcement and other down-to-Earth applications has received the prestigious Federal Lab Consortium Excellence in Technology Transfer Award.

To aid their space program research, two NASA scientists invented the Video Image Stabilization and Registration system, known as VISAR; however, this video-enhancement technology soon found broader applications.

The system works by making minute details in poor-quality video readable. The innovative technology was created by Dr. David Hathaway, a solar physicist at NASA Marshall Space Flight Center, and Paul Meyer, an atmospheric scientist at the National Space Science and Technology Center. Sammy Nabors, commercial technology lead at Marshall, was also recognized for his work as commercialization representative for VISAR.

VISAR was chosen for the honor from dozens of entries, including submissions from the US Department of Defense, Department of Energy and Department of Health and Human Services. Among other requirements, the innovations had to have potential for overwhelming positive impact on society and must have been commercialized into the private sector.

The award is coveted because a panel of experts from industry, state and local government, academia and other Federal Lab Consortium members judge entries.

The consortium promotes cooperation between government and private laboratories to exchange ideas and enhance the nation's economic competitiveness.

The scientists' foray into the world of forensics began when they helped the FBI analyze video of the bombing that killed two people and injured hundreds more at the 1996 Summer Olympic Games in Atlanta. Hathaway and Meyer successfully clarified nighttime videotapes made with handheld camcorders, revealing important details about the bomb and the bomber.

Why did the FBI come to NASA for help? As scientists, Hathaway and Meyer had developed equipment for enhancing images of the sun and Earth's atmosphere. They used this experience and worked together to invent the VISAR technology.

Since their first case with the FBI, Hathaway and Meyer have worked to refine their software. It has gained interest in the commercial sector because it can remove "snow" from video, correct zoom and camera jitter, as well as produce clearer images of moving objects by smoothing jagged edges and enhancing still images.

Marshall Space Flight Center currently has a license with Intergraph Corporation to use VISAR technology in their VideoAnalyst™ product. Marshall is offering the technology for license to software producers for home computer applications. VISAR is now widely used by public safety agencies across the United States. It also shows promising use for military and medical applications. □



The team responsible for developing VISAR earned the Federal Lab Consortium Excellence in Technology Transfer Award.

For more information, contact Sammy Nabors at ☎ 256/544-5226, ✉ [sammy.nabors@msfc.nasa.gov](mailto:sammy.nabors@msfc.nasa.gov). Please mention you read about it in **Innovation**.

## Review Brings New Launch Vehicle Closer

NASA is another step closer to defining the next-generation reusable space transportation system and successor to the space shuttle.

The Space Launch Initiative (SLI), a NASA-wide effort defining the future of human space flight, has completed its first milestone review, resulting in a narrower field of potential candidates for the nation's second-generation reusable space transportation system.

"To use the resources afforded by space, it's critical to increase reliability and safety while at the same time reducing the cost of space transportation," said Art Stephenson, director of NASA Marshall Space Flight Center, Huntsville, AL, which manages the SLI for the Office of Aerospace Technology. "The Space Launch Initiative is doing the groundwork to accomplish these goals and create a second-generation launch system."

"We're not just designing a launch vehicle," added Dennis Smith, program manager of the Space Launch Initiative at Marshall. "We're designing the complete system."

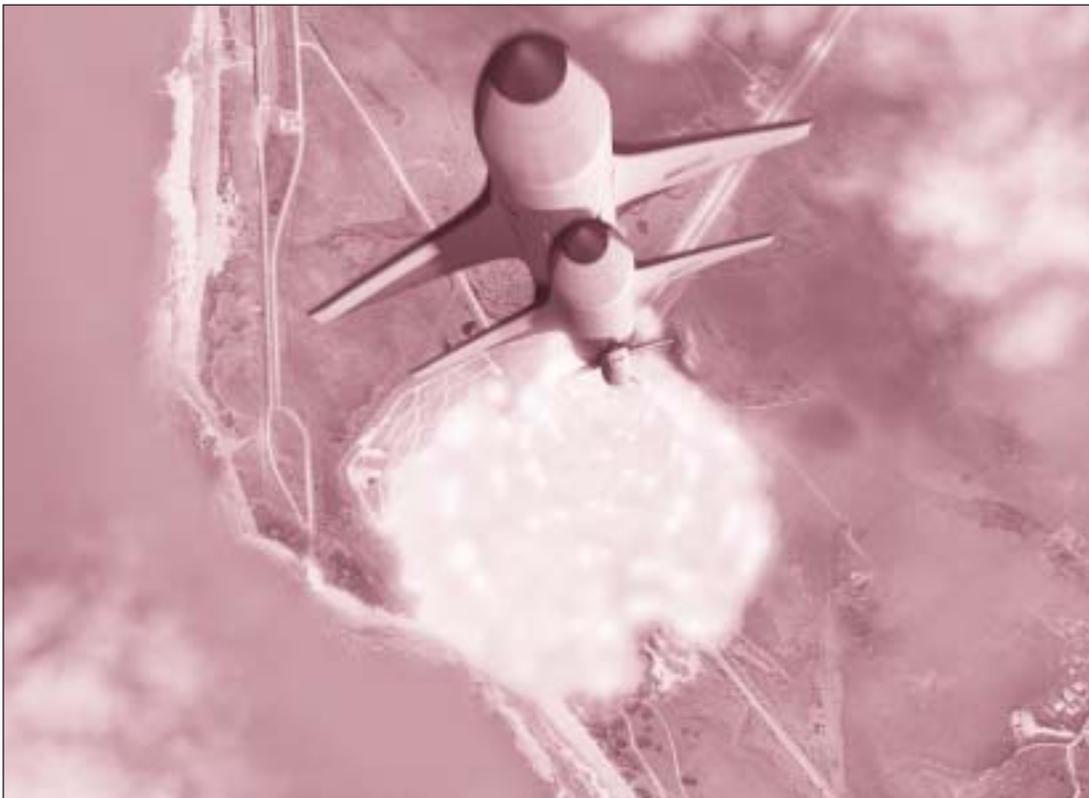
The recent review, called the Initial Architecture

Technology Review, analyzed and evaluated competing second-generation reusable space transportation architectures and technologies against NASA and commercial mission requirements, as well as safety and cost goals.

Architecture refers to the complete transportation system design—that is, the vehicles and their components that fly into space, as well as the ground operations needed for launch. The transportation system design includes an Earth-to-orbit reusable launch vehicle (the space shuttle is the first-generation reusable launch vehicle); on-orbit transfer vehicle and upper stages to put satellites into orbits; mission planning; ground and flight operations; and support infrastructure, both on orbit and on the ground.

Three contractor architecture teams—The Boeing Company of Seal Beach, CA; Lockheed Martin Corp. of Denver, CO; and a team including Orbital Sciences Corp. of Dulles, VA and Northrop Grumman of El Segundo, CA—presented dozens of potential architectures for review. Following the review, each

*Continued on page 17*



The next-generation reusable launch vehicle could look like this. Three contractor teams—The Boeing Company of Seal Beach, CA; Lockheed Martin Corp. of Denver and a team including Northrop Grumman of El Segundo, CA and Orbital Sciences Corp. of Dulles, VA—have each been working as part of the Space Launch Initiative to develop potential 2nd-generation reusable launch system architectures.

## Technology Opens Door to the Space Frontier

Engineers at the John F. Kennedy Space Center (KSC) are currently testing the newest in umbilical technology to support NASA's ambitious new Space Launch Initiative (SLI), also known as the second generation of reusable launch vehicles. The SLI program ultimately will carry space exploration from the endeavors of the space shuttle missions into another age of pioneering wherein people and businesses more routinely live, work and travel in space.

"Umbilicals are the lifeline of any Space Launch Vehicle," said Warren Wiley, KSC's SLI program manager. "Fluids including propellants, pressurization gasses and cooling systems, along with power, communications and instrumentation readings, all flow through the umbilical. As a result, these large devices are manpower intensive to mate, test and maintain."

Traditional umbilical systems release at vehicle liftoff (T-0) and can require extensive connection time, thereby reducing potential flight rate. The Smart Umbilical Mating System, three years in development by NASA and Rohwedder Systems of Oviedo, FL, will serve as a modern next-generation umbilical system.

"The concept is to replace a T-0 umbilical with an automated system that has a mate, demate and remate capability," said Tom Lippitt, a lead engineer at KSC. "The ability to quickly and reliably mate and demate umbilical connectors under automated control combined with remote connection verification capabilities would reduce the time and labor hours required to prepare for launch."

According to Lippitt, the Smart Umbilical Mating System will also serve as a test bed for the development of future launch vehicle technologies. Ice suppression, advance control and leak detection, and quick disconnects are all related to umbilicals and will benefit from further testing and improvements. Through the use of

the Smart Umbilical Mating System, these new technologies can be tested in cryogenic conditions.

"In addition to ground-based applications, planetary systems and rovers will require umbilical mating for propellant loading as well as electrical and data connection," said Lippitt. "The technology developed as part of this project may be applied to develop simple, reliable self-sufficient mating systems. Some of this work will be required to make certain missions and systems feasible, such as the Mars methane-fueled rovers."

Kennedy Space Center is responsible for managing the Ground Operations Project—NASA's effort to

reduce the risk associated with developing a second-generation reusable launch vehicle (RLV). They will accomplish this by defining, developing and testing technologies needed to access space safely and economically.

"The project will address SLI goals of reducing operating costs by reducing the maintenance and manpower needed to do the connections, and will increase safety by automatically performing hazardous tasks and reducing potential failure modes," said Wiley.

The Space Launch Initiative is a NASA-wide research and development program managed by the Marshall Space Flight Center. Its mission is to open space for commercial, scientific and personal pursuits, and to enable exploration of our universe by rendering space transportation much safer, less expensive and more reliable than current commercial launch vehicles. □

For more information, please contact Thomas Lippitt at Kennedy Space Center, NASA YA-D1, Kennedy Space Center, FL 32899, ☎ 321/867-1391, ✉ [thomas.lippitt-1@ksc.nasa.gov](mailto:thomas.lippitt-1@ksc.nasa.gov) or John Spears or Jeff Donahue at Rohwedder, Inc., 582 South Econ Circle, Oviedo, FL 32765, ☎ 407/359-7363, ✉ [info@rohwedder.com](mailto:info@rohwedder.com). Please mention you read about this technology in **Innovation**.

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## Review

*Continued from page 15*

retained a handful of possible candidates for the nation's next-generation reusable space launch system.

The review allows the SLI to target investments and support what the program manager called the "up-front homework part of the program"—furthering technologies to aid in the development of a second-generation reusable launch vehicle. Another review will be held in November to further narrow potential space transportation architectures to two or three choices.

"We're going to seek the final and best ideas from industry, academia and government," said Smith. With the final selection of an architecture, full-scale development of a reusable launch vehicle could begin around the middle of this decade.

Since propulsion systems require a long lead time to design, develop, test and evaluate, it isn't surprising that propulsion analysis was a chief driver through the recently completed review activity.

"We spent a lot of time analyzing propulsion technologies," said Smith. "Among the outcomes is a

focus on kerosene-fueled main engines." This focus is based on studies—conducted by the architecture contractors—that examine the performance of competing technologies in safety, reliability, cost and operability. Studies indicated that kerosene main engines have excellent potential to meet government and commercial needs. The second-generation vehicle will have a two-stage-to-orbit propulsion system based on engines fueled by all kerosene, all hydrogen or a combination of kerosene and hydrogen.

Dependable, long-life engines, along with crew escape and survival systems, and long-life, light-weight integrated airframes are among the SLI's highest priorities. Each greatly impacts the program's bottom line of increased safety, reliability and cost-effectiveness.

All NASA's Field Centers and the Air Force Research Laboratory are actively participating in the Space Launch Initiative. □

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For more information, visit the SLI Web site at [www.slinews.com](http://www.slinews.com).

## Advanced Technology Concept Selected for Test Flight

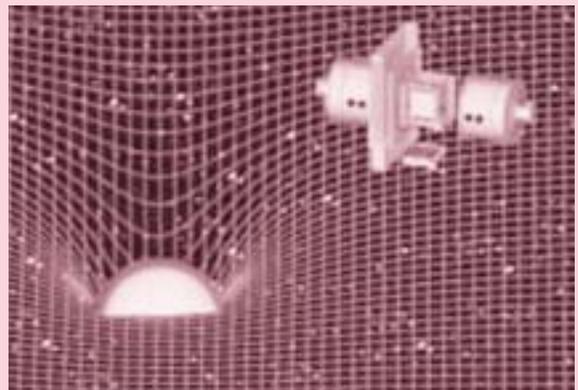
**N**ASA's New Millennium Program has selected two organizations to lead the work on sensor and thrust-producing technologies to control a space vehicle's flight path so that the payload responds only to gravitational forces.

The Disturbance Reduction System technology is scheduled to fly in 2006 as the Space Technology 7 project. Space Technology 7 is designed to test and validate advanced technologies for future use on NASA missions.

The total NASA funding for Space Technology 7 is \$62.6 million. The technology providers are Stanford University of Stanford, CA and Busek Company Inc. of Natick, MA. Stanford University will provide a highly sensitive gravitational reference sensor that will measure the position of a spacecraft with respect to an internal freely floating mass. The Busek Company will provide a set of miniature ion thrusters capable of controlling spacecraft position with extremely fine precision.

"The Disturbance Reduction System is a promising new technology that will pave the way for future space observations of gravitational waves, giving us a whole new eye on the universe," said Anne Kinney, director of the Astronomy and Physics division, Office of Space Science, NASA Headquarters.

The New Millennium Program was created in 1994 to identify, develop and flight-validate advanced technologies that can lower costs and enable critical performance of science missions in the 21st century. The program is managed by the Jet Propulsion Laboratory in Pasadena, CA for NASA's Office of Earth Science and Office of Space Science. □



In this artist's concept, a space vehicle responds to gravitational forces.

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For more information, contact Dr. William Folkner at the Jet Propulsion Laboratory, ☎ 818/354-0443, ✉ [William.Folkner@jpl.nasa.gov](mailto:William.Folkner@jpl.nasa.gov). Please mention you read about it in **Innovation**.

## NASA Selects Partner for Aviation Research

NASA has selected a partner for a joint venture to develop and demonstrate air mobility technologies for transportation using small aircraft and airports.

The National Consortium for Aviation Mobility (NCAM), of Hampton, VA, will lead a broad-based public/private consortium of more than 130 members, which is expected to grow. NCAM will work with NASA toward a mid-2005 proof-of-concept of new operational capabilities geared toward technologically advanced small aircraft and airports.

The proof-of-concept is a flight demonstration that will be the culmination of the NASA Small Aircraft Transportation System (SATS) research and technology program, led by NASA Langley Research Center, also in Hampton.

As envisioned, the SATS is an equitable, on-demand, point-to-point, widely distributed nationwide transportation system. It relies on advanced 4- to 10-passenger aircraft using new operating capabilities. Such a system promises improved safety, efficiency, reliability and affordability for small aircraft operating within the nation's 5,400 public-use landing facilities. This research will evaluate technologies and procedures that could significantly extend reliable air service to many communities. The impact of this research could be more equitable distribution of air-accessibility and economic opportunity.

Enabling the SATS vision requires transportation system innovations too risky and costly for any one entity to undertake; therefore, NASA is taking the first step on the path to the SATS vision—a proof-of-concept of the feasibility.

To implement proof-of-concept, NASA has opted to initiate a public/private partnership that includes the Department of Transportation, the Federal Aviation Administration (FAA) and NCAM. NASA believes this type of public/private venture will bring together key

transportation community stakeholders needed to guide the research and increase technology transfer and commercialization opportunities for all partners.

NASA and other federal agencies are expected to contribute up to \$40 million over the next four years to support the joint-sponsored research agreement—a cost-sharing partnership between the federal government and the consortium.

NCAM will lead a consortium of private businesses

and public entities spanning much of the nation. One of NCAM's early tasks will be to coordinate the technology development efforts of the members of the consortium with NASA's research. Consortium membership includes industry partners from the Advanced General Aviation Transportation Experiment Alliance Association Inc.; three state/regional SATLABS partnerships of Virginia, Maryland and Southeast (Florida and Georgia.),

and other state and local aviation authorities; airport operators; general aviation manufacturers; transportation services suppliers; transportation research institutions (including universities); pilot-training institutions; and suppliers of communication, navigation and surveillance systems for small transportation aircraft.

Langhorne Bond, a former FAA administrator with extensive experience in a broad range of public transportation fields, will serve as NCAM consortium president. John F. Sheehan will serve as NCAM executive director. Sheehan has more than 35 years of directly applicable experience in both the technical and business development aspects of the aerospace and defense industries. □

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NCAM will lead a consortium of private businesses and public entities spanning much of the nation. One of NCAM's early tasks will be to coordinate the technology development efforts of the members of the consortium with NASA's research.

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For more information, contact Michael Braukus at NASA Headquarters, ☎ 202/358-1979, ✉ [mbraukus@mail.hq.nasa.gov](mailto:mbraukus@mail.hq.nasa.gov). Please mention you read about it in **Innovation**.

## Health-Monitoring Toolkit Can Accelerate Innovation

Widespread use of online health management has the potential to deliver useful maintenance information and safety-related situational awareness while reducing lifecycle costs of equipment. This is why there is an increasing emphasis on health management and condition-based maintenance systems in engines, vehicles, factories and homes. Health management concepts are maturing and warrant experimentation, but the lack of software toolkits remains an obstacle for health-monitoring system designers, systems integrators and users. Existing solutions written for specific platforms to monitor specific subsystems tend to be costly and rarely get integrated into larger system-wide information management infrastructure. Online, automated techniques must be considered when latencies in delivering derived knowledge to the decision-makers adversely affect safety and efficiency.

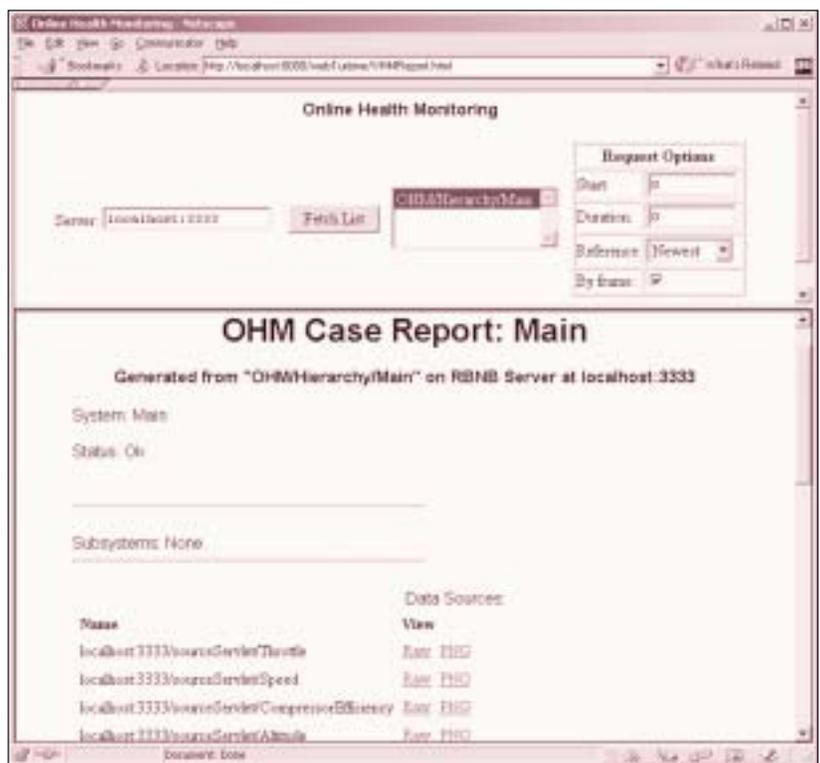
NASA Dryden has initiated an SBIR project with Creare, Inc., of Hanover, NH, to develop a suite of Java-based object-oriented software tools to aid the design, analysis, implementation and use of cost-effective distributed health management systems. While object-oriented paradigms with graphical interfaces are revolutionizing many fields, distributed health monitoring evolves toward intelligent decision support systems involving sensors, signal processing and a consequential need to analyze both current and historical data from a number of often-changing data sources and types. The Ring Buffered Network Bus (RBNB), a network data cache implemented as a hierarchical peer-to-peer high-performance information-sharing environment, is used in this project and is an ideal solution for this type of application. RBNB is itself the result of prior NASA SBIR commercialization efforts.

The goal of this project is to implement an advanced environment for engineering health-monitoring systems comprised of elementary entities like sensors and algorithms (virtual sensors) assembled into components, subsystems and systems. Through the capabilities enabled by RBNB, development activities like simulation, rapid prototyping, support of multiple users on distributed teams and integration of third-party software are straightforward and reduce the risks to the success of this project. In effect, the project goal is to create a distributed collabora-

tive environment for the engineering of distributed collaborative health-monitoring software. The expected result is distributed intelligent data processing and decision making that reduces bandwidth requirements through distributed processing while increasing data availability through network buffering and Web-based report delivery. A key capability of the toolkit will be to enable the configuration and initiation of remote algorithms that can consolidate raw sensor data into relevant health information at multiple levels and locations, significantly reducing network bandwidth requirements. In-depth data is still available for decision making through health reports, which may be generated automatically or on demand at the system, subsystem or sensor levels, and viewed with a standard Web browser. □

For more information, contact Larry Freudingner at NASA Dryden Flight Research Center, ☎ 661/276-3542, ✉ [l.freudingner@dfrc.nasa.gov](mailto:l.freudingner@dfrc.nasa.gov). Please mention you read about it in [Innovation](#).

Dryden Flight Research Center has initiated an SBIR project with Creare, Inc. to develop a suite of Java-based object-oriented software tools to aid the design, analysis, implementation and use of cost-effective distributed health management systems. Photo provided by Dryden Flight Research Center.



## SBIR Increases Durability of Composite Ceramics

A new coating material can greatly extend the lifetime of ceramic composites, making them more than 1,000 times more durable.

SBIR Phase I and II grants awarded to Advanced Ceramics Corporation (ACC) of Lakewood, OH by Glenn Research Center have led to the development of a family of high-temperature and doped boron nitride coatings that offer tremendous improvement in interface durability. The grants are part of a NASA campaign to study propulsion materials within its high-speed aircraft program.

These ACC-developed interface coatings circumvent moisture that complicates composite manufacture and ultimately degrades composite performance at high temperatures. The moisture-resistant coatings extend the shelf life of composite materials and resist thermal oxidation in moist air. Ceramic fibers woven into fabrics can now be coated with this advancement. The coating work is seen as a boon to the ceramic composites industry.

Wet oxidation is a major issue for fiber-reinforced

ceramic matrix composites operating under combustion conditions. Loss of the boron nitride interface between the silicon carbide fibers and the silicon carbide matrix leads to rapid material property degradation. During the Phase II effort, commercial sales of these coatings on silicon carbide fibers have grown considerably.

Ceramic composites are a new type of material made by reinforcing refractories with high-strength ceramic fibers. They are as strong as metal, yet can withstand higher temperatures. One immediate use for composite materials is in turbine engines—an application that can make the engines far more efficient.

Industrial gas-fired power turbines that have ceramic composite combustor liners and shrouds can compress fuel and air at higher temperatures than all-metal turbines, which increases efficiency. The turbine can produce more kilowatt hours from the same fuel than it could if metal combustor liners and shrouds were used—a big advantage in the com-

*Continued on page 21*

## SBIR Spinoff Benefits Homeland Security

Making the best possible decisions in highly uncertain and time-constrained environments, like relief operations for natural and manmade emergencies, requires communication tools that help individuals and teams work together to achieve results that are greater than the sum of the individual actions. System developers at Polexis, Inc., of San Diego, CA, have introduced VIGILYS, a network-centric distributed collaboration and analysis environment tailored to the needs of groups and individuals that will implement the emerging national strategy for homeland security.

VIGILYS is a decentralized application built on event-by-event data-sharing technology that decouples source and destination at multiple layers within the architecture. Participants in the collaboration network do not need prior knowledge about each other's information in order to visualize and exchange it. The result enables emergency response teams to easily collect, integrate, analyze and share information in real time with others that have a need to know.

On one level, this decoupling action is enabled by a patent-pending integration platform called Extensible Information Systems (XIS™) that uses XML and advanced software agents. To give the network underneath the decoupled memory and performance features needed to easily manage collaboration with continuously changing data streams, Polexis researchers use the patented Ring Buffered Network Bus (RBNB) technology, by Creare, Inc. of Hanover, NH. RBNB is

a product of an SBIR investment through NASA Dryden Flight Research Center, while the origin of XIS is attributable to DARPA investment.

"It is a great pleasure to see something we developed be so effectively transitioned and used for public benefit," said Larry Freuding, co-inventor of the RBNB and lead for advanced engineering environments at NASA Dryden. VIGILYS is an example of the inherent value of federal technology investment strategies, according to Kimberly Holly, vice president of operations and strategy for Polexis. "It's quite an exciting accomplishment to take technologies, independently developed through the SBIR process and DARPA, and create a solution that can offer great value to government and commercial enterprises worldwide." □



An SBIR spinoff enables emergency response personnel to easily collect, integrate, analyze and share information in real time.

For more information, contact Larry Freuding at NASA Dryden Flight Research Center, ☎ 661/276-3542, ✉ [l.freuding@drc.nasa.gov](mailto:l.freuding@drc.nasa.gov). Please mention you read about it in **Innovation**.

# New Camera Benefits Astronomy and Medicine

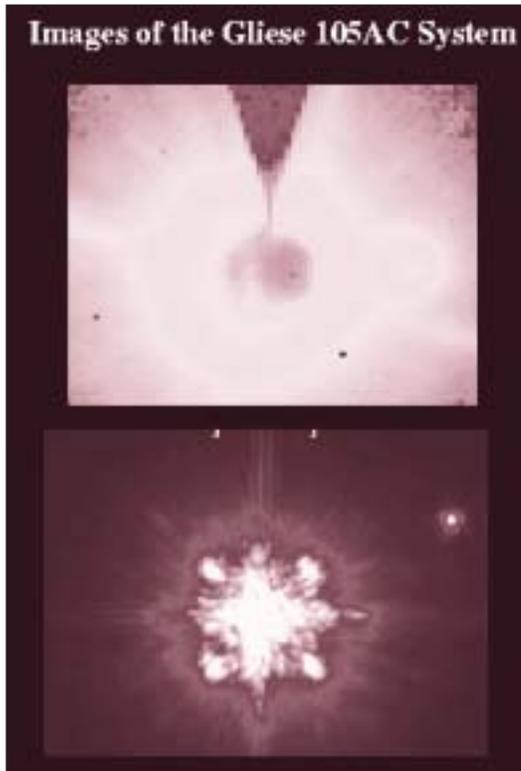
New imaging technology has significantly increased the capability of the 200-inch Hale telescope at the Mount Palomar Observatory. This new technology is adaptive optics, a combination of deformable mirrors and very sensitive high-speed cameras that makes it possible to correct for distortions caused by the atmosphere. The distortions are the same as the familiar phenomenon of twinkling stars. The technique for correcting the image involves monitoring distortions in the image of a nearby bright reference star with high-speed cameras. Alternatively, a laser beam is bounced off the stratosphere, providing a point source of light for gauging the distortion. This information is used to rapidly adjust a deformable mirror to correct for distortions in the image seen by the telescope. Scimeasure Analytical Systems, Inc. developed the new camera technology under a NASA SBIR contract managed at the Jet Propulsion Laboratory.

An image of two companion stars where the smaller star could barely be distinguished from the larger star's glare is now seen as two clearly separate stars. This important innovation allows astronomers to study the spectrum of light from the smaller companion without the overwhelming glare of the larger star, making it possible to learn significantly more about the smaller star's composition and history.

Studies are now underway for the next generation of large terrestrial-based telescopes. The California Institute of Technology and the University of California are collaborating on the design of the California Extremely Large Telescope (CELT).

The light-gathering segmented mirror for this 30-meter-wide telescope is composed of approximately 1,000 individual mirrors. Scimeasure Analytical Instruments has been selected to provide the cameras for this telescope. In space, adaptive optics will correct for distortions caused by changes that distort the mirrors and lenses of the telescopes that collect the image.

This same camera technology is breaking new ground in neurological science and cardiovascular research. The cam-



The top picture was taken at the Mount Palomar Observatory with the aid of a coronagraph, which is a circular disk blocking direct light from the larger star. The lower picture was taken with the same telescope, using adaptive optics without the aid of the coronagraph technique.

era's high speed and sensitivity make it possible to capture rapid chemical reactions in sections of tissue under study without concern for distortion. The camera is able to capture the short bursts in chemical activity at very low levels of light intensity. The biomedical field has been an important market for cameras from Scimeasure Analytical Instruments and a valuable example of how NASA/SBIR-developed technology benefits the private sector of the economy. □

For more information, contact Byron Jackson at the Jet Propulsion Laboratory, ☎ 818/354-1246, 📠 818/354-2385, ✉ [Byron.L.Jackson@jpl.nasa.gov](mailto:Byron.L.Jackson@jpl.nasa.gov). Please mention you read about it in **Innovation**.

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## SBIR Increases

*Continued from page 20*

petitive and very cost-conscious power turbine industry.

Aircraft turbine engines with composite liners and shrouds also weigh less than all-metal turbines, allowing the aircraft to carry a larger payload or fly a longer distance using the same fuel. "More pay-

load and more distance from the same engine and the same fuel" is the mantra of civil aviation. □

For more information, contact Mike Dowell of Advanced Ceramics Corporation ☎ 440/878-5699 📠 440/878-5927 ✉ [dowellm@advceramics.com](mailto:dowellm@advceramics.com). Please mention you read about it in **Innovation**.

## Technology Opportunity Showcase

Technology Opportunity Showcase highlights some unique technologies that NASA has developed and that 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**.

### Electronic Timecard System

NASA Kennedy Space Center (KSC) is now seeking to transfer the Electronic Timecard (ETC) System for use in commercial applications. This computer-based, automated system was developed to replace a cumbersome and error-prone paper-based system for recording employees' work hours. Prior to the implementation of the ETC, employees had to complete a paper timecard and ensure that it arrived at a central location each Monday morning for processing by the payroll department. Problems encountered by payroll included a 10-percent rejection rate for incorrect site codes, improper charge numbers, inaccurate totals, missing signatures and other errors.

With the ETC system, employees can easily keep their timecards up to date and accurate through simple time-field entries. The system simplifies the daily entry of work hours for employees, who select job codes from lists provided by supervisors. Supervisors can also review employees' timecards electronically from their own office at any time during the week. Both employees and supervisors use electronic signatures to verify the information. Through this electronic submittal process, timecards can be turned in on time and without the risk of being lost or misplaced.

This process also enhances quality assurance activities by providing payroll and human resources departments with the ability to generate various reports more easily and efficiently. This streamlined process reduces data entry costs and errors. The system also facilitates the addition of new hires into the system and the reassignment of employees to other departments/supervisors.

Potential commercial uses of the ETC system include any business or organization with a large workforce wishing to streamline its payroll procedures and save money by reducing or eliminating time-consuming timecard collection.

The Electronic Timecard software was written in Visual Basic 3 for use with SQL Server 6.5 and runs in Windows 95 or Windows NT. NASA seeks to transfer this software free of charge to qualified US companies for their own internal use. However, any company or individual desiring the software for commercial purposes must apply for a license from NASA. □

For more information, please contact Lynne Henkiel, SERTTC Industry Liaison, ☎ 321/867-8130, 📠 321/867-2050, ✉ [Lynne.Henkiel-1@ksc.nasa.gov](mailto:Lynne.Henkiel-1@ksc.nasa.gov). Please mention you read about it in **Innovation**.

### Spray-On Circuits In-Situ Thin-Film Circuitry

NASA offers companies the opportunity to license a revolutionary process that can permanently bond ultra-thin markings, including complex integrated

circuits, onto most surfaces.

Researchers at NASA Marshall Space Flight Center developed a new thin-film deposition process that creates a permanent bond between the film and substrate. This patented process, known as vacuum arc vapor deposition (VAVD), can be performed using a traditional vacuum chamber or a handheld vacuum device developed by NASA. Applications are numerous, including a new method for creating integrated circuits such as smart tags, radio frequency identification devices (RFID) and memory devices.

The process deposits thin films in-situ on virtually any metallic and some nonmetallic surfaces; applies easily using a vacuum chamber or portable handheld device; creates a permanent bond between the film and substrate; produces very thin high-quality films; uses masks to produce high-definition symbols or integrated circuits; improves the deposition rate compared to other processes; and eliminates hazardous wastes or byproducts.

VAVD technology can be used to create any kind of mark or film on a part. Typical marks include simple patterns for bar codes or two-dimensional data matrices and complex patterns for RFID or memory devices. VAVD is useful for a number of industrial applications, including asset tracking, inventory management, component health monitoring, smart cards, smart devices and wireless communications.

The VAVD technology can produce thin-film coatings in the form of small, high-fidelity part identification symbols that can be read by humans or machines. VAVD can also provide an alternative semiconductor manufacturing process. With VAVD, integrated circuits can be permanently built onto the substrate of virtually any part using layers of thin-film deposition. Because the size and operation of a traditional vacuum chamber limits both the size and volume of parts being marked, NASA developed a portable handheld vacuum device that can apply markings. NASA has tested VAVD with a number of films and substrates. Types of thin films sprayed include chrome, copper, aluminum, stainless steel, titanium, gold, silver, silicon, cobalt, iron, nickel and various ceramics. Types of substrates include various metal surfaces, PVC, ceramics, paper, mineral surfaces (such as rocks) and feathers.

The VAVD technology portfolio includes issued and pending patents. NASA invites companies to consider using this technology through exclusive or nonexclusive field-of-use licensing. □

For more information, contact Sammy Nabors at Marshall Space Flight Center, ☎ 256/544-5226, ✉ [sammy.nabors@msfc.nasa.gov](mailto:sammy.nabors@msfc.nasa.gov). Please mention you read about it in **Innovation**.

# NCTN Directory



## 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](mailto:cblake@mail.arc.nasa.gov)

### Dryden Flight Research Center

Selected technological strengths are Aerodynamics, Aeronautics Flight Testing, Aero-propulsion, Flight Systems, Thermal Testing and Integrated Systems Test and Validation.

#### Jenny Baer-Riedhart

Dryden Flight Research Center  
Edwards, California 93523-0273  
661/276-3689  
[jenny.baer-riedhart@mail.dfrc.nasa.gov](mailto:jenny.baer-riedhart@mail.dfrc.nasa.gov)

### Glenn Research Center

Selected technological strengths are Aero-propulsion, Communications, Energy Technology and High-Temperature Materials Research, Microgravity Science and Technology, and Instrumentation Control Systems.

#### Larry Viterna

Glenn Research Center  
Cleveland, Ohio 44135  
216/433-3484  
[Larry.A.Viterna@grc.nasa.gov](mailto: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.

#### Nona Cheeks

Goddard Space Flight Center  
Greenbelt, Maryland 20771  
301/286-5810  
[ncheeks@pop700.gsfc.nasa.gov](mailto:ncheeks@pop700.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

Jet Propulsion Laboratory  
Pasadena, California 91109  
818/354-2577  
[merle.mckenzie@jpl.nasa.gov](mailto:merle.mckenzie@jpl.nasa.gov)

### Johnson Space Center

Selected technological strengths are Life Sciences/Biomedical, Spacecraft Systems, Information Systems, Robotic and Human Space Flight Operations.

#### Charlene Gilbert

Johnson Space Center  
Houston, Texas 77058  
281/483-0474  
[charlene.e.gilbert@jsc.nasa.gov](mailto:charlene.e.gilbert@jsc.nasa.gov)

### Kennedy Space Center

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

#### Jim Aliberti

Kennedy Space Center  
Kennedy Space Center,  
Florida 32899  
321/867-6224  
[jim.aliberti-1@kmail.ksc.nasa.gov](mailto:jim.aliberti-1@kmail.ksc.nasa.gov)

### Langley Research Center

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

#### Wilson Lundy

Langley Research Center  
Hampton, Virginia 23681-0001  
757/864-6005  
[w.l.lundy@larc.nasa.gov](mailto:w.l.lundy@larc.nasa.gov)

### Marshall Space Flight Center

Selected technological strengths are Materials, Manufacturing, Non-Destructive Evaluation, Biotechnology, Space Propulsion, Controls and Dynamics, Structures and Microgravity Processing.

#### Vernotto McMillan

Marshall Space Flight Center  
Huntsville, Alabama 35812  
256/544-2615  
[vernotto.mcmillan@msfc.nasa.gov](mailto:vernotto.mcmillan@msfc.nasa.gov)

### Stennis Space Center

Selected technological strengths are Propulsion Systems, Test/Monitoring, Remote Sensing and Non-Intrusive Instrumentation.

#### Kirk Sharp

Stennis Space Center  
Stennis Space Center, Mississippi  
39529-6000  
228/688-1914  
[kirk.sharp@ssc.nasa.gov](mailto: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.

Bill Musgrave  
**Ames Technology Commercialization Center**  
San Jose, CA  
408/557-6820

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

Wayne P. Zeman  
**Lewis Incubator for Technology**  
Cleveland, OH  
440/260-3300

David Kershaw  
**Florida/NASA Business Incubation Center**  
Titusville, FL  
321/267-5601

Bridget Smalley  
**University of Houston/NASA Technology Center**  
Houston, TX  
713/743-9155

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

Julie A. Holland  
**NASA Commercialization Center/California State Polytechnic University**  
Pomona, CA  
909/869-4477

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

Ann Lansinger  
**Emerging Technology Center NASA Business Incubator**  
Baltimore, MD  
410/327-9150

## Small Business Programs

Carl Ray  
NASA Headquarters  
**Small Business Innovation Research Program (SBIR/STTR)**  
202/358-4652  
[cray@hq.nasa.gov](mailto: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](mailto: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 agencies and to foster collaboration between public and private sector organizations. They also can direct you to the appropriate point of contact within the Federal Laboratory Consortium. To reach the RTTC nearest you, call 800/642-2872.

Ken Dozier  
**Far West Technology Transfer Center**  
University of Southern California  
Los Angeles, CA 90007  
213/743-2353

William Gasko  
**Center for Technology Commercialization**  
Westborough, MA 01581  
508/870-0042

David Bridges  
**Economic Development Institute**  
Georgia Institute of Technology  
Atlanta, GA 30332  
404/894-6786

Gary F. Sera  
**Mid-Continent Technology Transfer Center**  
Texas A&M University  
College Station, TX 77840  
979/845-8762

Charlie Blankenship  
**Technology Commercialization Center, Inc.**  
Newport News, VA 23606  
757/269-0025

Pierrette Woodford  
**Great Lakes Industrial Technology Center**  
Battelle Memorial Institute  
Cleveland, OH 44070  
216/898-6400

Joseph P. Allen  
**National Technology Transfer Center**  
Wheeling Jesuit University  
Wheeling, WV 26003  
800/678-6882

Dan Winfield  
**Research Triangle Institute Technology Applications Team**  
Research Triangle Park, NC 27709  
919/541-6431

## 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/ Awards/ Heads-Up

### Events

**Sensors Expo & Conference** is being held Sept. 23–26, 2002 at the Greater Boston Convention and Visitors Bureau Boston, MA. This event will allow attendees to discover ways to reduce time to market and increase competitive advantage. It also will showcase emerging technologies and how to use them. Sensors Expo brings together a broad range of tech-

nologies that are shaping sensing, MEMS, data acquisition, control and communications. Extra focus will be on solutions for the automotive, aerospace, defense, medical device, white goods and general design and manufacturing sectors.

For more information, visit <http://www.sensorsexpo.com/boston2002/V31/index.cvn>

### Awards

A NASA history of the Soviet human space flight program received the **Emme Award for Astronautical Literature** at a luncheon of the Goddard Memorial Symposium, sponsored by the American Astronautical Society. Named in honor of the first NASA Historian, Eugene Emme, the Emme award was created in 1982 to annually recognize an outstanding book that increases public understanding of the past and potential impact of the field of astronautics. Details on ordering the book can be found at <http://history.nasa.gov/gpo/order.html>

Two NASA Internet sites were honored with **Webby Awards**, sponsored by the International Academy of Digital Arts and Sciences. The Webby Awards recognize Web sites that are both aesthetically exceptional and which utilize technology to help build communities.

The NASA Home Page, which serves as the Agency's entryway into its more than four million public World Wide

Web pages, won the Webby's People's Voice Award in the Government & Law category. The Earth Observatory, an interactive site that highlights news and imagery about NASA's Earth science research, won the People's Voice Award for Science. The two sites are the fourth and fifth NASA sites to be selected for this honor during the past six years.

Previous winners include the following:

-- Mars Pathfinder (<http://mars.jpl.nasa.gov/MPFI/>): 1998 People's Voice for Science

-- Science@NASA (<http://science.nasa.gov/>): 1999 People's Voice for Science

-- Starchild (<http://starchild.gsfc.nasa.gov/>): 1998 Webby for Education

The full list of winners and nominees can be found on the Internet at <http://www.webbyawards.com>

### Heads-Up

NASA's annual publication, **Spinoff**, documents NASA technologies initially developed for space missions and commercialized by industry for the development of products and services. Look for the next issue, **Spinoff 2002**, in October, and visit the *Spinoff* Web site at

<http://netsrv.casi.sti.nasa.gov/tto/spinoff.html> or <http://nctn.hq.nasa.gov>



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