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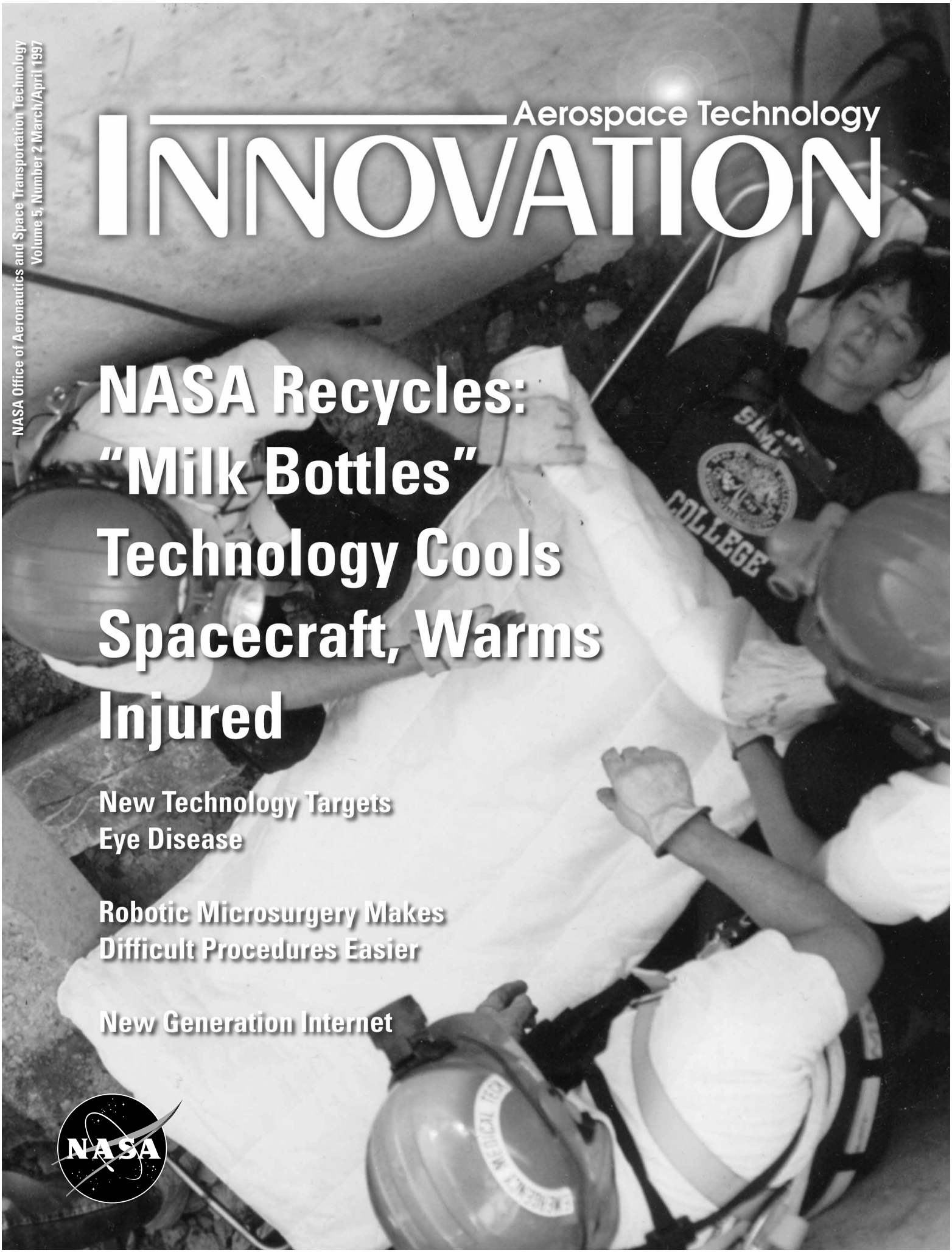
Aerospace Technology

INNOVATION



NASA Recycles: "Milk Bottles" Technology Cools Spacecraft, Warms Injured

New Technology Targets Eye Disease

Robotic Microsurgery Makes Difficult Procedures Easier

New Generation Internet

NASA

Aerospace Technology
INNOVATION

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About the Cover: Ames Disaster Assistance and Rescue Team (DART) simulates a rescue using a blanket made from recycled milk bottles.

On-Line 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
3/97	STS-83 MSL-01	Astro-Plant Generic Bioprocessing Apparatus Vapor Diffusion Apparatus (microgravity research including two proteins for structure-based drug design related to Chagas' Disease)	BioServe Space Technologies Center for Macromolecular Crystallography
9/97	STS-86** Shuttle/Mir-07	Commercial Generic Bioprocessing Apparatus Liquid Phase Sintering (samples going to *Mir*)	BioServe Space Technologies Consortium for Materials Development in Space
1/98	STS-89** Shuttle/Mir-08 Shuttle/Mir-08	Materials In Devices as Superconductors ASTROCULTURE™ X-ray Detector Test	Langley Research Center Wisconsin Center for Space Automation and Robotics Center for Macromolecular Crystallography

Key STS—Space Transportation System

*As of March 1997
**These payloads go over to *Mir* for extended operations of about four months and return on the next Shuttle/Mir mission.

WELCOME TO INNOVATION

Changing the Place, Face and Pace of SBIR/STTR

by Carl G. Ray, SBIR/STTR Executive

WELCOME TO THE NEW SECTION ON THE Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs! The winds of change sweeping through NASA have left many fresh and new looks about the agency. The SBIR and STTR programs are no exception. Now under the Office of Aeronautics and Space Transportation Technology, we have increased the pace of strategic, administrative and operational enhancements to the programs.

Congress established the SBIR program in 1982 to increase opportunities for small businesses to participate in federal research and development (R&D), increase employment and improve overall U.S. competitiveness. Specific program objectives are to stimulate U.S. technological innovation, use small business to meet federal R&D needs, foster and encourage participation in technological innovation by socially and economically disadvantaged persons and increase private-sector commercialization of innovations derived from federal R&D. In 1992, legislation was enacted to extend and strengthen the SBIR program, increasing the emphasis on the commercial application of resulting SBIR project products. In addition, that year's legislation authorized the STTR program, which is similar to SBIR in policy, objectives and structure, but requires cooperative research between a small business concern and a nonprofit research institution (that is, a university, a federally funded research and development center or a federal laboratory).

INNOVATIVE SOLUTIONS
+ COMBINED COMMITMENT
= COMMERCIAL SUCCESS.

The pace of change in the program has been rapid over the last few months. While there continue to be major program enhancements at the management levels, there are strategic shifts as well. The strategic focus for the programs center around cultivating innovative solutions to NASA needs, facilitating small business commitment in developing new and innovative technologies and maximizing the potential for commercialization of any technologies developed. As for innovative solutions to NASA needs, one strategic change is the programmatic alignment of SBIR/STTR with the strategic planning and direction of the NASA Strategic Enterprises.

Therefore, solicitation research topics and resulting selections are aligned with Enterprise strategic planning outcomes and focused on the high-priority technology needs of the agency. Subtopics will be more significantly influenced by the needs of each NASA Enterprise—Aeronautics, Human Exploration and Development of Space, Mission to Planet Earth (MTPE) and Space Science. Along with this alignment, NASA's SBIR/STTR strategies are using the Internet to make outreach information more available to small businesses in terms of the solicitation process, and a network of NASA Technology Transfer Centers is providing access to technical and commercial assistance resources throughout all program phases.

The SBIR/STTR programs have succeeded in technology developments that have led to dual-use applications in NASA missions and commercial products. For example, NASA's MTPE program is using ultraviolet instruments with SBIR technology developed at Barr Associates, Westford, Massachusetts, to study a variety of phenomena. NASA's uses of the filters include (1) the Imaging Science Subsystem of NASA's Cassini mission to assist in generating images of Saturn in the infrared, visible and ultraviolet ranges of the spectrum and (2) the Methane Raman Lidar System to study atmospheric methane, an important greenhouse gas. Barr Associates has applied what it learned to develop new filters for commercial applications, such as small filters that help make what were once tabletop instruments into portable units. These filters, used mainly in portable miniature spectrometers, are sold to commercial laboratories. NASA also is funding an SBIR project with Thermacore, Inc., Lancaster, Pennsylvania, for systems that require heat rejection, such as for the Space Shuttle and Space Station. These heat pipes are used to cool the main central processor "chip" in notebook computers. The pipes provide industry-leading performance and have received strong market acceptance both domestically and overseas since their introduction in May 1995.

SBIR/STTR program activities continue to seek ways to maximize the agency's benefit through the program—specifically, to provide the small business community opportunities to develop technology that meets NASA's needs and commercial applications. Armed with a recognition that the small business community is rich in innovative potential, the SBIR/STTR program continues to find new ways to maximize the opportunities for innovative solutions to become commercial successes. ✿

For more information about SBIR/STTR, contact Carl Ray at NASA Headquarters. 202/358-4652. Please mention you read about it in *Innovation*.

TECHNOLOGY TRANSFER

The Optical Broadcasting Wind Indicator provides a remote display of wind speed and direction more accurately and at a further distance than a windvane.

New Wind Indicator Enhances Aviation Safety

A NEW NASA TECHNOLOGY WILL HELP MAKE the air over noncontrolled airports safer. Workers at NASA's Kennedy Space Center (KSC) have developed the Optical Broadcasting Wind Indicator. The technology recently was transferred to Atlas Technology Corporation of Boca Raton, Florida, for commercial development.

The new self-contained wind indicator provides a remote display of wind speed and direction more accurately and at a further distance than a windvane or windsock. The device broadcasts measured wind speeds and direction information via optical flashes from a high-intensity strobe light co-located with the sensors.

Atlas Technology President Jim Gizzie said the wind indicator will decrease greatly the chance of mid-air collisions at noncontrolled airports (airports where no control tower is in operation), because pilots will not have to fly over the field's windsock to learn wind direction and speed for landing determination. Inventor Jan Zysko, a KSC aerospace engineer, said the wind indicator also would save fuel costs because pilots will not have to overfly the airport to visually acquire the windsock, then circle the airport or retrace their flight paths to enter the proper traffic patterns.

Gizzie said pilots can receive wind information as close as five miles from an airport, so they may prepare for landing sooner. This new technology eliminates the need to fly in potentially congested airspace to find an airport's windsock so the pilot may determine the wind's direction. The wind indicator also permits pilots to select the best runway to use before entering the airport's airspace.

The wind indicator also could be used for navigation; it would allow pilots earlier and more efficient pattern entry at noncontrolled airports. The wind indicator's strobe light and unique flash pattern would help pilots locate an airport more easily in reduced-visibility conditions.

The indicator signals via the interval between a single "start" flash and multiple "end" flashes, which are linearly proportional to the measured wind direction. The indicator uses a scaling factor of 30 degrees per second to allow for a convenient determination of wind direction in either degrees azimuth or compared with the standard 12-hour clock positions rounded to whole numbers. For example, a three-second time interval would correspond to winds from the three o'clock position or from 90 degrees (east). A precise measure of wind direction is possible by stopwatch timing and multiplying the measured time interval by 30. Wind speed is encoded in the number of "stop" flashes. Two end flashes would indicate that the winds are zero to 10 knots; three end flashes would indicate winds from 10 to 20 knots, four flashes would show winds from 20 to 30 knots, and so on. Most applications would not require a greater resolution of speed ranges.

Others who could benefit from the wind condition and direction information are firefighters, ski resort operators and boaters, Gizzie said. He added that the chemical industry could use the wind indicator to monitor atmospheric plumes.

For more information about the Optical Broadcasting Wind Indicator, contact Jan Zysko at Kennedy Space Center. 407/867-4925, *Jan.Zysko-1@kmail.ksc.nasa.gov* Or contact Jim Gizzie at Atlas Technology. 561/997-2697, *jgizzie@atlastechnology.com* Please mention you read about it in *Innovation*.

New Chemistry and a New Company From a NASA Solution

A NASA SOLUTION TO A SPACE SHUTTLE problem gave birth to a new type of chemistry and a new company. NASA's Johnson Space Center developed a revolutionary technology that founded Flowing Discharge Radical Chemistry (FDRC), which is the basis for FlowGenix, a Webster, Texas, biomaterials company that has exclusive license to the FDRC technology and its use for treating various materials, including porous polymers.

The early Space Shuttles were losing protective tiles during reentry. This problem was serious because losing too many tiles could cause the Shuttle to burn up on reentry. NASA investigated and found that the glues used to hold the tiles in place were chemically modified by reactive gases while

the Shuttle was in low-Earth orbit. New materials were tested that solved this problem and led to FDRC changes in surface characteristics.

Space near Earth is a vacuum that contains oxygen and other reactive gases activated by the Sun. These gases may be produced under Earth conditions but at high energy, which has damaging effects to polymer materials. FlowGenix's breakthrough process produces new "cold" reactive gases that modify surfaces without damage.

A gas stream flows under low pressure through a special reactor in FDRC. The reactor's shape and electric design allow a large volume of reactive atoms or molecules, called "radicals," to form as gas moves through the plasma zone. The gas cools and becomes more pure as it diffuses away from the plasma zone. The gas gently but thoroughly modifies any surface it touches.

These gases are very reactive and extremely small and carry no electric charge, allowing them to penetrate deeply into porous materials. The reactions that take place leave molecular "hooks" that change the character of the polymer surface and also may be used as starting points for other chemical reactions. This change turns a simple material into a high-tech, high-value-added component.

Flowing discharge technology allows DNA synthesis supports, chromatography media and diagnostic cassettes to be made from inexpensive porous sintered polymer filters, which can be loaded interstitially for biochemical purposes. These products have greater loading capacities, superior flow rates, good dimensional stability, less reagent utilization, significantly lower cost and flexibility in design. They shorten biopharmaceutical development and production cycle times substantially and drive down the costs of commercialization and manufacturing for chemical and biotechnological products.

FlowGenix will focus initially on biotechnology applications for disposable products to make and purify DNA. Markets for small- and large-scale synthesis supports and chromatography products are expected to exceed $300 million this year and $900 million by 2001.

For more information about this technology, contact Dr. Jill D. Fabricant at FlowGenix. 281/316-1070, *jfabricant@flowgenix.com* Or visit FlowGenix's web site: *www.flowgenix.com* Please mention you read about it in *Innovation.*

Cable Helps Lightning Protection

LIGHTNING CAN WREAK HAVOC ON ELECtronic equipment, but a cable designed by a North Carolina inventor provides homeowners a level of protection not available before, saving homeowners millions of dollars in damages if its use is widespread. Sam Gasque of Protective Wire and Cable invented Lightning Retardant Cable (LRC), which improves lightning protection over standard coaxial cable by at least 700 percent.

Gasque has been developing LRC since 1985; he patented it in 1993. Engineers at NASA's Kennedy Space Center (KSC) helped him prove his product, Gasque said.

LRC's two-choke design keeps lightning from traveling through the cable and into a person's home. It can deter lightning damage to expensive electronic equipment, such as satellite dish systems, antennas, television cable systems and sprinkler systems.

The first choke, a "drain wire," is wrapped around the cable at an angle. Gasque said studies of lightning show that it travels along a straight path. The spiraled drain wire in Gasque's design "at every turn cancels out the lightning's magnetic field" as it begins to travel the cable. The second choke, a "spiral shield," is at another angle in the opposite direction. Gasque said this wire acts as an inductor and "enhances the cancellation of a lightning strike."

KSC and Marshall Space Flight Center's Outreach Program are helping Gasque decide what adjustments, if any, would be needed in the drain wire if larger cable were used. Gasque said LRC has been tested "in the confines of a lightning strike." It was installed in several homes on a South Carolina island that has a history of frequent lightning strikes. LRC's performance was monitored for several years, during which it took several direct hits. Gasque said not once was lightning carried into the homes through LRC.

"If you use Lightning Retardant Cable, it will greatly reduce the chances of lightning damage. This doesn't take the place of a surge protector unless it has a coax[ial] hookup. But, this might redirect the effects elsewhere," Gasque said.

Runway lighting systems at airports also may be protected by LRC. All airports have some degree of

lightning problems, Gasque said, and runway lights could suffer extensive damage in the event of a lightning strike, especially if an underground stream is near the runway.

A Canadian company manufactures LRC. A North Carolina company, Consumer Lightning Products, packages the cable for home-use customers, Gasque said.

For more information, contact Sam Gasque at Protective Wire and Cable. 704/696-2890. Please mention you read about it in *Innovation.*

Remote Sensing Helps Make Home Buying Easier

NASA AND A MISSISSIPPI REALTOR ARE WORKing together to find a better way for prospective home buyers to find a new house. Coast Delta Realty owner Jon Ritten of Diamondhead, Mississippi, was interested in a computerized way for showing buyers many different aspects of property without actually having to leave the office. To do this, he called on the Commercial Remote Sensing Program (CRSP) at NASA's Stennis Space Center for its expertise in remote sensing. CRSP is an element of NASA's Office of Mission to Planet Earth.

Remote sensing uses sensors that are either based on the ground or mounted on aircraft and spacecraft to view the Earth. Ground-based remote sensing systems look out over the horizon, while air- and space-based systems look down on the Earth's surface. Pictures or imagery acquired from these systems are combined with related information to produce up-to-the-minute maps, track weather events, measure terrain, map forests and wetlands, find agricultural problems and create databases of urban infrastructure.

A Global Positioning System is set up in Diamondhead, Mississippi, so that a very detailed digital mapping system can be developed.

Ritten and CRSP developed a very detailed digital mapping system of the Diamondhead area, showing numerous characteristics of developed and undeveloped property. Ritten provided CRSP with the common real estate questions and concerns, and NASA used remote sensing to help provide the answers.

"Working with NASA, I thought I would be dealing with folks who wouldn't understand what I was trying to do, and I certainly wouldn't understand the technology," said Ritten. "I was very surprised that our communication and interface was very simple. CRSP personnel have taken the technology down to a level that, as a layman, I can understand. It's been a very easy process for me."

"The connection between satellite remote sensing and real estate is natural," said Richard Campanella, a remote sensing/geographic information systems specialist with Lockheed Martin at Stennis. "People looking for real estate—prospective home buyers—become geographers. So an airborne or satellite image is a natural way to communicate geographic information."

CRSP collected remotely sensed imagery over Diamondhead, primarily using airborne sensors, and put it into a computer mapping system. The imagery was then referenced to the geographic location in Diamondhead and interpreted by CRSP to identify specific geographic information, such as potential flood areas, percent of shade on the lot, setback distance between the street and the house, visibility from a particular house, areas of interest in a neighborhood, and sites of houses, stores, developments and retail areas.

"I think with the information products this technology will offer, it is going to allow the industry to provide more services to their clients and perhaps cut down on the necessary efforts by the sales representatives to meet the needs of their clients," said Cliff Holle, another Lockheed Martin remote sensing/geographic information systems specialist.

The remote sensing information obtained also has many other applications outside of the real estate industry. Insurance underwriters, engineering firms, local/municipal government, investors and emergency planners may use this same information to determine risk, build a road, create a base map, site a shopping mall or plan an evacuation route.

For more information, contact Bruce Davis at Stennis Space Center. 601/688-2042, 601/688-7455, *crsphome@ssc.nasa.gov* Please mention you read about it in *Innovation.*

Business Incubator Aids Florida Community

A FLORIDA BUSINESS INCUBATOR IS ANOTHER way for NASA to make its technological expertise available to budding small businesses. NASA has teamed up with Florida's Technological Research and Development Authority and Brevard Community College to provide new technology-based businesses a healthy environment in which to build a future.

The mission of the Florida/NASA Business Incubation Center (FNBIC) is to increase the number of successful technology-based small companies originating in, developing in or relocating to Brevard County. By offering affordable space and shared office equipment and services, the incubator makes it possible to reduce the costs associated with establishing and operating a business.

"Our support facilities and programs will train and nurture entrepreneurs and help them have the best possible chance of success. Assisting technology-based entrepreneurs and small businesses at their infancy by offering office space at a reduced cost and providing appropriate seminars and guidance enhances the possibility of a business succeeding," said FNBIC Executive Director Maria Clark.

The incubator is providing a social benefit to Brevard County by encouraging technology-based small businesses to relocate to or stay on the Space Coast. Officials hope the incubator will offset impacts caused by federal agency downsizing.

The center's nearness to NASA's Kennedy Space Center (KSC) provides firms access to NASA expertise and laboratories. NASA's participation accelerates KSC's technology transfer mission. "Supporting small businesses with our high-technology infrastructure could lead to new products and jobs in Brevard County," said KSC Program Manager Kathleen Harer. "We encourage the tenants to mix and match with one another and provide support and work with one another."

Three businesses currently operate at the incubator, which opened August 6, 1996. The 10,000-square-foot facility can house up to 20 startup businesses and offers production space as well as offices. For an annual fee, the incubator also is open to offsite clients that are technology-based entrepreneurial companies. The offsite clients can attend seminars, workshops and gatherings at the incubator and have access to the center's common area, conference room, classrooms, audio visual equipment and select business services.

The Florida/NASA Business Incubation Center's goal is to increase the number of successful technology-based small companies originating in, developing in or relocating to Brevard County. Open house guests learn more about some of the businesses already participating in the program.

Current tenants are Mr. and Mrs. Brain, Infotech Systems, Inc., and American Services Technology, Inc. Offsite clients include Atlantic Research and Technologies, Inc., Coconut Telecomp, Inc., and SRS Technologies.

Harer said co-funding by Florida and Brevard Community College makes the project unique. Brevard Community College's in-kind contributions include the facility, security, utilities and maintenance support. Tenants also have access to the college's computer labs, library and shops. ✿

For more information, contact Maria Clark at the Florida/NASA Business Incubation Center. 407/383-5200. Or contact Kathleen Harer at Kennedy Space Center. 407/867-8035. Please mention you read about it in *Innovation*.

NASA Partners for Faster, More Reliable Gas Sensor

MERCO INC. LICENSED A NONMECHANICAL gas sensor from NASA's Langley Research Center in November after a two-year negotiation process facilitated by the Mid-Continent Technology Transfer Center (MCTTC). The sensor, originally developed for measuring gases in the Earth's atmosphere from aircraft and spacecraft, will monitor gaseous pollutants discharged from petroleum refineries and chemical manufacturing plants. The device, named the Gas Filter Correlation Radiometer (GFCR), has several advantages over conventional gas sensors, including

capabilities for remote sensing and area source monitoring, higher reliability, faster response, single-gas measurement and a more compact design.

The MCTTC learned about the air quality consulting firm, MERCO, in 1994 through the Colorado Innovation Foundation. The foundation is one of the MCTTC's regional affiliates. After meeting with MERCO to discuss its plans to conduct air quality tests, MCTTC Project Manager Ferdinand Chew identified Langley's gas sensor technology at Technology 2004, a NASA-sponsored showcase for federal government technologies.

Chew then guided MERCO through market searches and encouraged it to team with a strong manufacturer. "He located the technology and put us in touch with the right people," said MERCO Vice President Moe Bonakdar.

One of those right people, Dr. Frank Farmer of Langley's Technology Applications Group, says Chew's ability to see the GFCR as a product for MERCO was exceptional. The connection, Farmer said, was not readily apparent on first inspection.

Much of the GFCR's conversion potential comes from its all optical, nonmechanical design. The GFCR is more accurate and requires less maintenance than other sensors, Bonakdar said, adding that it requires little calibration and blocks interference, such as humidity and temperature, remarkably well. "Because of less interference, you get a more accurate reading—and more speed," he said.

MCTTC expertise also was crucial in cementing the license agreement between MERCO and Langley, according to both Farmer and Bonakdar. The MCTTC's Monty Coats worked diligently, Farmer said, to make sure that each organization understood the perspective of the other. Also, Bonakdar said Coats helped MERCO convince NASA that it could commercialize the GFCR as successfully as a large corporation.

Once the license was signed, which took place at a White House Conference on Environmental Technology in Colorado, MERCO enlisted the University of Colorado at Denver to build and test a product prototype, Bonakdar said. MERCO plans to start selling the sensor in about a year. ✿

For more information, contact Ferdinand Chew at the Mid-Continent Regional Technology Transfer Center (MCTTC). ✆ 409/845-8605, ✉ *ecchew@teexnet.tamu.edu* Or contact Monty Coats at the MCTTC. ✆ 512/342-4225, ✉ *ecmcoats@teexnet.tamu.edu* Please mention you read about it in *Innovation.*

ACTS Links Rural Patients With City Doctors

RURAL RESIDENTS ARE RECEIVING THE same high-quality medical care as their big city cousins because of innovations in telemedicine technology from NASA's Advanced Communications Technology Satellite (ACTS). Coupling ACTS with the Telemedicine Instrumentation Package (TIP), developed by Krug Life Sciences and NASA's Johnson Space Center to monitor the health of astronauts in space, could save lives.

On Earth, TIP works as a portable diagnostic center, incorporating examination tools and audio-video equipment into a suitcase-sized package. ACTS and TIP together become a life-saving tool, enabling a rural health care professional to send for evaluation a patient's vital information to a hospital hundreds or thousands of miles away.

NASA's Lewis Research Center (LeRC) manages ACTS. LeRC professionals presented this trailblazing technology during a staged trauma last summer at St. Vincent Hospital, Billings, Montana. St. Vincent Hospital doctors used TIP and a 23-inch ultra-small aperture terminal to examine patients at an Exxon refinery and at Crow/Northern Cheyenne Hospital to demonstrate the practical applications of satellite technology in remote settings.

"The demonstration was an important step in promoting the role of satellites in the telemedicine field," said Nancy Horton of the ACTS Experiments Office. "Doctors were pleased with the 'diagnosis quality' high-resolution audio, video and data transmission provided by ACTS and TIP. We're confident that this technology will become a

The NASA/Krug Life Sciences Telemedicine Instrumentation Package is a portable diagnostic center.

viable means for expanding access to state-of-the-art medicine regardless of geographic boundaries."

Krug Life Sciences has seen an interest in the commercial production of TIP, Horton said. TIP is estimated to sell for $30,000 to $50,000 per unit when available commercially, probably in two years or less.

The ability of ACTS to provide on-demand, integrated communications makes it an ideal platform to test technology. Such technology will open doors to new types of telemedicine, such as mammography. Obtaining annual mammography screenings can be difficult for rural patients—especially when the closest hospital is 300 miles away. ACTS would eliminate long waits for results and return trips for additional tests by connecting small town clinics and mobile mammography vehicles to the experts at urban hospitals.

LeRC, Cleveland Clinic and the University of Virginia have initiated the Telemammography Using Satellite Communications Project to develop and demonstrate technologies and methods that will deliver high-quality, high-resolution mammography images using low-cost, high-access global satellite networks. ACTS provides the direct link to mammography experts at large medical facilities for populations that lack high-data-rate terrestrial communications. ✱

For more information, contact Jennifer Sibits at Lewis Research Center. 216/433-8142, 216/433-6371, *Jennifer.J.Sibits@lerc.nasa.gov* Please mention you read about it in *Innovation.*

Robotic Microsurgery to Make Difficult Procedures Easier

A NEW ROBOTIC-ASSISTED SURGICAL SYSTEM will enable doctors to perform delicate operations to the eye, ear, spine, heart and brain with greater dexterity. NASA and Dr. Steve Charles of MicroDexterity Systems, Memphis, Tennessee, co-developed Robotic-Assisted MicroSurgery (RAMS).

Charles originated the concept of a telerobotic system as a tool to assist the microsurgeon. However, Jet Propulsion Laboratory (JPL) engineers developed RAMS based on surgical requirements provided by Charles and using previously developed NASA telerobotics technology. Many new innovations have been developed under the RAMS task. "This system will put surgeons on the same playing field. The system will allow a whole subset of people who do not have the physical dexterity to perform surgery to stay in the game. It's a dexterity enhancer," Charles said. JPL's Tom Hamilton added, "RAMS takes the most skilled surgeon and makes his or her skills better. RAMS can improve surgical techniques to allow faster and safer procedures."

Charles said RAMS augments surgical dexterity the same way a microscope improves a surgeon's vision during an operating room procedure. The primary control mode of RAMS is teleoperation, in which the operator's hand motions are transferred by a sophisticated joystick-like hand-controlled device. The new system has features that enhance a surgeon's manual positioning and tracking. RAMS will help a surgeon overcome involuntary jerks and hand tremors, which can limit a doctor's fine-motion skills.

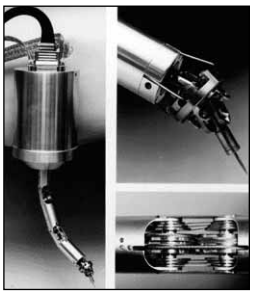
RAMS will allow relative positioning of surgical tools within 20 millionths of a meter. The technology will enable the surgeon to range freely over a continuous work space as large as a cubic inch. Surgeons would be able to scale down their hand motions as much as 5 to 10 times and perform new procedures in critical areas such as the retina and ear. JPL officials said RAMS will enable surgeons to operate at unprecedented small scales. Those capabilities will include force-reflection and textural feedback.

Potential NASA applications include extra- and intravehicular activity telescience, bioprocessing, material process assembly and micromechanical assembly. It may also have Space Station-related applications in biomedicine, Hamilton said.

The first element of the RAMS work station is being tested now. It is a six-degrees-of-freedom surgical robot or slave made up of a torso-shoulder-elbow body with a three-axis wrist. The robot manipulator is about 10 inches long and 1 inch in diameter. This portion was developed in 1984 at JPL. The slave holds and positions the surgical tool. The master unit was developed in 1995 and feeds instruction to the slave device. The unit also can measure the surgeon's range of motion.

Actual clinical testing of the system will begin this spring. MicroDexterity Systems will commercialize the system following the testing of RAMS in the operating room, Charles said. ✱

For more information, contact Tom Hamilton at Jet Propulsion Laboratory. 818/354-7344. Or contact Dr. Steve Charles at MicroDexterity Systems, Inc. 901/767-6662. Please mention you read about it in *Innovation.*



JPL and MicroDexterity Systems are developing a robotic microsurgery device with important implications for such delicate surgeries as eye and brain. The device uses computer-compensated motion control to dramatically reduce the effects of operator muscle tremor.

ADVANCED TECHNOLOGIES

Robotic Helicopter Offers New Option for Public Safety

A NEWLY DEVELOPED REMOTE-CONTROLLED helicopter will be able to perform precision crop spraying, border patrols, hazardous spill inspection, fire surveillance, crowd security and emergency medical delivery more safely and cost effectively. NASA and the U.S. Army have developed the Free Flight Rotorcraft Research Vehicle (FFRRV), a robotic helicopter that can carry a movie camera, still camera, video downlinks, night vision cameras or infrared cameras. Artificial intelligence techniques keep the chopper stable in flight and allow it to be remotely controlled from the ground.

"An autonomous helicopter could help perform all of these jobs better, more quickly, at a lower cost while not exposing any humans to potentially dangerous situations," said Todd Hodges, an Army employee at NASA's Langley Research Center in Hampton, Virginia. According to Hodges, who serves as the manager of the helicopter project, the robotic helicopters could also be used for pollution monitoring, law enforcement, bridge and building construction inspection, crop and forest monitoring, mine clearing and other public security tasks. "It could even be used as a carrier pigeon, shuttling supplies and so forth between military locations. The potential applications are pretty wide-ranging," Hodges added.

The FFRRV was initially developed as a tool to test flight dynamics. Hodges and his team were asked to develop a suitcase-portable version, including a small helicopter and a ground control station consisting of a moving map and video monitor. Hodges said there also was the stipulation that the system setup would take no more than 20 minutes.

The prototype helicopters are powered by a modified gasoline engine. The helicopters are about six feet long including the rotor diameter. According to researchers, the FFRRV can fly at speeds up to 60 miles per hour.

Hodges said inquiries about the technology have come in from various federal government agencies, film industry officials, power and pipeline companies and local fire departments. ✿

For more information, contact Nicole Forest at Langley Research Center. 757/864-5036. Please mention you read about it in *Innovation.*

A Shuttle-Eye View for Kids

NASA IS BRINGING THE FRONTIERS OF SPACE exploration to students in 15 U.S. middle school classrooms via the World Wide Web. KidSat is a three-year pilot education program that uses an electronic still camera aboard the Space Shuttle. The program, a partnership among the Jet Propulsion Laboratory (JPL), the University of California at San Diego (UCSD) and Johns Hopkins University Institute for the Advancement of Youth, was launched with *Atlantis* earlier this year for the second time.

KidSat's mission operations center at UCSD is staffed with undergraduate and high school students during the Shuttle mission. The center is modeled after Mission Control at NASA's Johnson Space Center (JSC). The students receive telemetry from the Shuttle on their computer monitors and can listen to and receive instructions from NASA's flight controllers over direct channels to JSC.

The KidSat mission operations team monitors the Shuttle's progress continuously, providing up-to-date information to the middle school students who use the Internet to request photographs of specific regions of the Earth. When the image requests have been verified by KidSat mission operations, they are compiled into a single-camera control file and forwarded electronically to the KidSat representatives at JSC. They pass this file on to the flight controllers, who uplink it to an IBM Thinkpad connected to the KidSat camera. Software on the Thinkpad, developed by students working at JPL, uses these commands to control the camera.

Once taken, the photographs are sent to the KidSat Data System at JPL, staffed by high school students during the mission, and posted on the World Wide Web for the students to study and analyze. The Institute for the Advancement of Youth and UCSD are developing the curriculum for the middle school students and teachers.

Some of the topics the students explored during the first KidSat mission were weather, biomes, the relationship between history and geography and the patterns of rivers on the landscape. Students also could search for impact craters and study the relationships of center pivot irrigation fields with available water supply.

Images and student results are posted on the KidSat home page. Interested public school districts, teachers and students may view the images and information provided by students during and

after the mission via this World Wide Web site: *http://www.jpl.nasa.gov/kidsat*

The KidSat pilot program is sponsored by NASA's Office of Human Resources and Education with support from the Offices of Space Flight, Mission to Planet Earth and Space Science.

For more information, contact Dr. JoBea Way at Jet Propulsion Laboratory 818/354-8225, *way@lor.jpl.nasa.gov* Please mention you read about it in *Innovation.*

Sensors Provide a Safe Platform for Volcano Studies

NASA SCIENTISTS ARE DEVELOPING A variety of airborne and spaceborne remote-sensing tools to study potentially dangerous volcanoes. These scientists have created computer visualization products, such as three-dimensional flyover video animation clips, that help study volcanic changes.

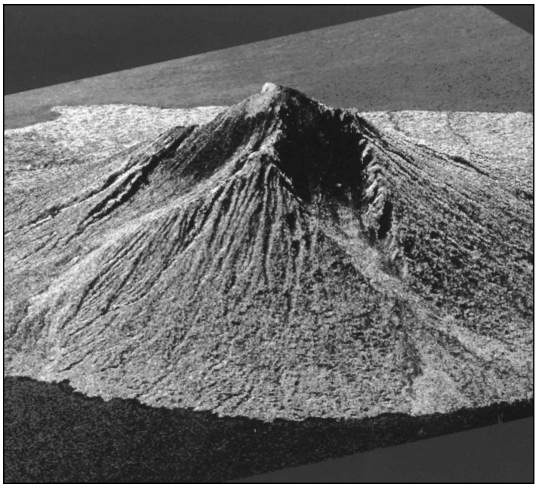
Using information collected with Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar (SIR-C/X-SAR), Airborne Synthetic Aperture Radar (AIRSAR), the Airborne Emission Spectrometer (AES), the Thermal Infrared Multispectral Scanner (TIMS), the airborne Laser Altimeter Facility and the Shuttle Laser Altimeter, the scientists are able to map the changes. Six domestic volcanoes are being studied: Mount St. Helens and Mount Rainier in Washington, Mount Shasta and Lassen Peak in California and Kilauea and Mauna Loa in Hawaii.

Dr. Jeffrey Plaut, a scientist at NASA's Jet Propulsion Laboratory (JPL), said, "Imaging radar is a particularly useful tool for studying volcanoes because the radar is able to see through the weather and volcanic clouds. It's a good tool for mapping new volcanic deposits because of the radar's sensitivity to texture such as ash and different types of lava flows."

Dr. James Garvin of NASA's Goddard Space Flight Center said, "By combining the radar data with information from scanning laser altimeters, we are now tracking changes at the summits of Mount St. Helens and Mount Rainier that will document the impact of erosion, climate and other factors on the topography and stability of large volcanoes."

In recent months, AIRSAR, AES and TIMS were aboard a NASA DC-8 that captured images of the New Guinea Manam volcano within hours of an eruption. "The airborne instruments help us map the topography from safe distance," said Ellen O'Leary, AIRSAR science coordinator at JPL.

JPL's Digital Image Animation Laboratory (DIAL) turns the scientific data into three-dimensional video animation and other images. DIAL is best known for visualizations of planetary data sets of Venus and Mars.



NASA scientists are developing remote-sensing tools that can map the changes in potentially dangerous volcanoes. A NASA imaging system aboard a DC-8 aircraft obtained this 3-D image of the eruption of the volcanic island of Manam, New Guinea.

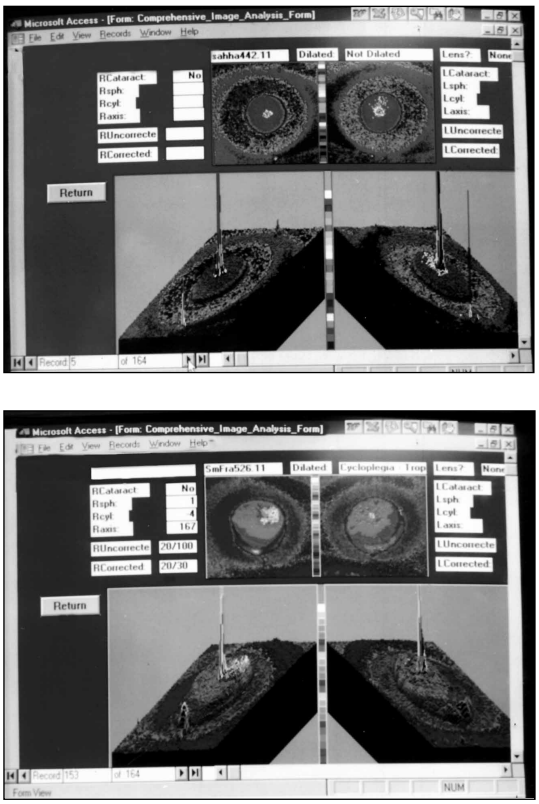
AIRSAR uses three radar wavelengths and can collect data in both vertical and horizontal polarization. AIRSAR can collect three-dimensional topographical data in its TOPSAR mode to create digital elevation models. TIMS collects image data in the thermal infrared portion of the spectrum and operates at six channels between 8 and 12 micrometers.

For more information, contact Dr. Jeffrey Plaut at Jet Propulsion Laboratory. 818/393-3799, 818/354-0966, *jeffrey.plaut@jpl.nasa.gov* Or contact Dr.Vincent Realmuto at Jet Propulsion Laboratory. 818/354-1824, 818/393-6962, *vincent.realmuto@jpl.nasa.gov* Please mention you read about it in *Innovation.*

New Technology Targets Eye Disease

A HUNTSVILLE, ALABAMA, EYE SURGEON HAS used a NASA technology utilization grant to develop a diagnostic system that could enable physicians to instantly diagnose many eye diseases and disorders. Dr. S. Hutson Hay has established Kudi Kalu, Inc. This new biomedical firm has received permission from the U.S. Food and Drug Administration to market the digital retinoscopic photometer.

The photometer is the result of work begun with a 1980 grant from NASA's Marshall Space Flight Center. Through its Technology Transfer Office, Marshall funded an experiment to detect amblyopia through the use of generated retinal reflexes. That study's results, combined with technological innovations, medical discoveries and his own insights during the past 15 years,



The digital retinoscopic photometer captures an eye disease via light reflected on the retina. Reflected images can be captured, digitized and analyzed on a computer.

The top image shows two normal eyes. The bottom image shows cataracts in both eyes.

have enabled Hay to develop the digital retinoscopic photometer. According to Hay, the prototype instrument is about the size of a personal computer and fits easily into a small examining room.

"The concept is simple," Hay said. "An optical disease that distorts light passing from the outside, through the eye to the retina, thereby impairing vision, would equally degrade the reflected light going back in the other direction. A major problem arises in getting light to pass from inside the eye, out. Reflecting light off the retina accomplishes this. These reflected images can then be captured, digitized and analyzed on a computer. We've all seen animals' eyes reflect the light of automobile headlights at night. Human eyes can be made to do the same thing."

Hay said each eye disease seems to have a unique reflection "signature," which changes in a set pattern as the disease progresses. Hay can determine the optical quality of the eye and the quality of binocular vision in children and adults. Of particular importance is the device's ability to evaluate the vision of children too young to speak, thereby enabling the physician to detect and treat conditions such as amblyopia and crossed eyes early enough in life to be of help.

Children find the test painless. The instrument requires nothing more from patients than just sitting in front of it. It is totally objective and requires no response from the patients other than keeping their eyes open. It also is safe, noninvasive, fast and inexpensive.

Hay said eventually the device could enable physicians to assess the size of cataracts and to monitor their growth. This information will permit the physician to make informed decisions about surgery.

The database of reflected light patterns of different types of eye diseases at various stages of development is being compiled by Hay. More data will be accumulated, and the computer will "learn" to associate distinct patterns with individual diseases and disorders as the photometer moves into more general use. With a large enough database, it should be possible to have a computerized instrument able to provide highly accurate diagnoses and electronically assess stages of disease development.

For more information, contact Dr. Hutson Hay, 310 Clinton Avenue West, Huntsville, AL 35801. 205/533-7330, 205/533-6261, *shaymd@HiWAAY.net* For more information on-line, open *http://iquest.com/~kudikalu/* Please mention you read about it in *Innovation.*

Future Internet Faster

NASA IS INVOLVED IN AN INITIATIVE THAT could result, by 2002, in information flowing a million times faster than today's modern home computer modems and a thousand times faster than a current standard T1 business computer line. Ames Research Center (ARC) will lead NASA's $30 million portion of a three-year $300 million federal project to develop Next Generation Internet (NGI). Other federal agencies involved include the National Science Foundation, the Department of Defense's Advanced Research Projects Agency, the Department of Energy, the National Institutes of Health and the National Institute of Standards and Technology.

Christine Falsetti, NGI project manager at ARC, said, "We want to guarantee levels of service that will eliminate slowdowns and network stagnation that users sometimes have to endure now while waiting for Internet images, movies and other services."

President Clinton endorsed the NGI concept in his State of the Union address earlier this year. NASA and other federal agencies will conduct research and development that could interconnect "core sites" with high-speed lines late this year, Falsetti said. The next step is to connect GigaPOPs across the United States, she added.

A "GigaPOP" is a regional group of core organizations that will connect their separate computer network systems by high-speed communications lines. An example of a GigaPOP in the greater San Francisco Bay area would be the high-speed linking of ARC, Lawrence Livermore Laboratory, University of California at San Francisco and Stanford University. A

"POP" is a "point of presence," and "Giga" stands for a billion computer bits.

"The federal government is going to hook up about 100 universities, research laboratories and other institutions at a hundred times the speed of today. NASA now has five research sites connected at 155 megabits (155 million bits per second)," NASA Program Manager Bill Feiereisen said. The NASA sites include ARC, Goddard Space Flight Center, Langley Research Center, Lewis Research Center and Jet Propulsion Laboratory. The centers soon will be converted from 155 megabits to 622 megabits, Feiereisen said.

"Over time, we will improve GigaPOP interconnects so that they can transmit computer data at faster and faster rates," Falsetti said. Medical use of NGI is expected to be very significant. "You'll go to your local doctor, and he will be able to consult with specialists across the globe. That will mean you can get access to the best medical expertise in the world," she said.

NGI initially will be a national network, Falsetti said. However, international partners are being sought. ✱

For more information, contact Christine Falsetti at Ames Research Center. 415/604-6935, ✉ *cfalsetti@mail.arc.nasa.gov* Please mention you read about it in *Innovation.*

DS1 Software Resembles HAL

NASA IS PREPARING THE MOST ADVANCED spacecraft artificial intelligence software yet. The software is being developed for launch aboard the New Millennium program's Deep Space One (DS1) spacecraft.

DS1 may sound like the fictional HAL 9000 main computer from the landmark science fiction tale *2001: A Space Odyssey*. The robotic DS1 carries no crew and is much smaller than the spaceship in the movie. However, DS1's computer artificial intelligence program, known as the "Remote Agent," shares the same basic goal of operating and controlling a spacecraft with minimal human assistance.

"We don't want to give the impression that Remote Agent is an artificial life form. However, the software will logically reason about the state of the spacecraft, and the Remote Agent will consider all of the consequences of its actions," said Kanna Rajan of NASA's Ames Research Center (ARC).

DS1 is the first scheduled mission in NASA's New Millennium program, which is designed to test and validate cutting-edge technology for the systems and instruments aboard future NASA science spacecraft. The Remote Agent development is a collaborative effort of ARC and Jet Propulsion Laboratory (JPL). "The goals of the Remote Agent development are to reduce the cost of exploration and to extend exploration to realms of space where no ground-controlled craft could venture," said Dr. Bob Rasmussen of JPL.

ARC's Barney Pell added, "Remote Agent should enable future spacecraft software to be more easily designed. The first version will be the hardest to write. After that, we can copy it for the next mission and make improvements rather than developing the software from scratch."

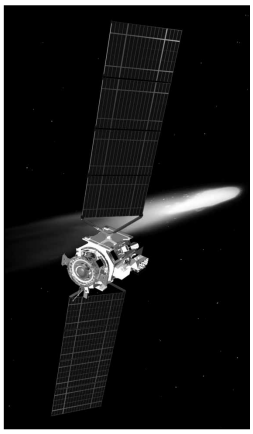
Given NASA's continuing efforts to develop many smaller, less expensive science aircraft, "we also need to perform each mission with less than a dozen ground controllers instead of the hundreds of people now needed to run a major planetary science mission," said Dr. Brian Williams, a DS1 team leader.

The "High Level Planning and Scheduling" part of Remote Agent will constantly look ahead to the schedule for several weeks of mission activities. "'Planner' is mostly concerned about scheduling spacecraft activities and distributing resources such as electrical power,'' said Dr. Nicola Muscettola, team leader for the planning software.

The model-based "Fault Protection" portion of Remote Agent, known as "Livingstone," functions as the mission's virtual chief engineer. Dr. P. Pandurang Nayak of ARC said, "If something should go wrong with the spacecraft, Livingstone would use the computer model of how the spacecraft should be behaving to diagnose failures and suggest recoveries."

The third part of Remote Agent is "Smart Executive." This portion of the software will act like an executive officer, issuing general commands to fly DS1. "The 'Executive' has to be able to execute the plans that are produced by the Planner and Livingstone,'' Pell said. ✱

For more information, contact Doug Bernard at Jet Propulsion Laboratory. 818/354-0880. Or contact Scott Sawyer at Ames Research Center. 415/604-6522. Please mention you read about it in *Innovation.*



Artist's conception of NASA's Deep Space One (DS1) spacecraft scheduled for launch in 1998.

Shuttle Experiment Studies Hypertension

RATS WITH HIGH BLOOD PRESSURE FLYING on a recent Space Shuttle mission may help scientists better understand how calcium helps maintain human health. Drs. David McCarron and Daniel Hatton, hypertension specialists from the Oregon Health Sciences University, Portland, are examining calcium's role in blood pressure regulation. Calcium has long been recognized as a critical mineral in normal development and the function of bone and muscle.

"A large body of evidence indicates that problems in the way the body processes calcium also can lead to hypertension," Hatton said. "This flight experiment will help us clarify the role calcium levels play in this condition."

Hypertension affects more than 50 million Americans and contributes to heart attack, stroke and kidney disease. It costs the nation's health care system billions of dollars annually, McCarron said. Dietary calcium seems to have its greatest effect on blood pressure when calcium demands on the body are highest.

McCarron and Hatton were among the first to propose that adequate dietary calcium is essential for normal cardiovascular function. They have tested their hypothesis in studies with humans and rats with normal and elevated blood pressures. The model for their studies is the "Spontaneously Hypertensive Rat," which is genetically predisposed to calcium-related high blood pressure. It is thought that space flight causes an increase of bone loss from the skeleton and a decrease in intestinal absorption of dietary calcium. The study of this animal model enables investigators to determine how dietary calcium modifies calcium metabolism and blood pressure in space.

NASA and the National Institutes of Health (NIH) are interested in how changes in gravity affect calcium metabolism because the loss of bone mass during space flight may cause osteoporosis in astronauts earlier than Earth-bound people. Bones, which support the body against gravity's pull, shed calcium into the blood and out of the body because bones are not weight-bearing in space. The shedding process begins immediately upon leaving Earth's gravity and seems to continue for the entire time in microgravity. An astronaut's mass in supporting bones drops 8 to 10 times faster than the corresponding loss of bone mass for aging people on Earth after just a few months.

The experiment, known as NIH–R4, included rats on both high-calcium and low-calcium diets. Scientists are conducting tests on the rats to discern how different calcium intakes affected blood pressure and cardiovascular functioning in microgravity. NASA's Ames Research Center is the experiment developer. For more information, see the NIH-R4 home page at: *http://weboflife.arc.nasa.gov/EXPLORATIONS/MISSION/nihr4.html* ✿

For more information about NIH-R4, contact Dr. Daniel Hatton at Oregon Health Sciences University. 503/494-8464, *hattond@ohsu.edu* Please mention you read about it in *Innovation*.

COLUMBIA EXPERIMENTS COULD SAVE LIVES

Biotechnology experiments conducted aboard the Space Shuttle *Columbia* (STS-80) in late 1996 could have far-reaching implications for breast cancer victims and heart transplant recipients. The Consortium for Materials Development in Space at the University of Alabama at Huntsville (UAH) and Instrumentation Technology Associates (ITA) jointly sponsored the Commercial ITA–MDA Experiments–05 (CMIX–05) payload. CMIX uses microgravity for biotechnology research to develop services and processes to generate materials.

John Cassanto of ITA served as industry participant program manager, and Dr. Marian Lewis managed project and commercial investigators for UAH. An optical system recorded the experiments for the first time. Formal results are due soon.

"I am delighted to report that our preliminary 'quick look' results for the UAH CMIX–05 payload indicate an unqualified success for all the UAH commercial principal investigations," said Lewis. ITA research of commercial biomolecules, such as cytokines, hormones, enzymes and specialized proteins, included the growth of urokinase crystals for breast cancer research.

The Consortium for Materials Development in Space researched aligned heart muscle cells for transplantation. The center foresees the eventual production of transplantable cells or tissues not available through standard Earth-bound processes. Other experiments involved anti-cancer compounds from plant cells, the improved encapsulation of islet cells for diabetes treatment, the evaluation of calcium dynamics in a model animal (mysid shrimp) system and the evaluation of cytokine secretions by lymphocytes. ✿

For more information, contact Dr. Marian Lewis at the University of Alabama at Huntsville. 205/890-6553, 205/890-6376, *lewisml@emailuah.edu* Please mention you read about it in *Innovation*.

Discoveries From Shuttle Experiments Could Have Great Impact

SIGNIFICANT SCIENTIFIC DISCOVERIES FROM experiments conducted on two recent Space Shuttle missions could greatly improve life on Earth. NASA researchers, astronauts and university scientists responsible for the space-based experiments outlined their discoveries at a recent conference at the National Academy of Sciences, in Washington, D.C., held to mark the one-year anniversaries of the second U.S. Microgravity Laboratory (USML–2) and the third U.S. Microgravity Payload (USMP–3) missions.

Their discoveries are expected to lead to better synthetic drugs, less expensive alloys and metal products, improved environmental cleanup, a greater understanding of weather and climate and a greater knowledge of how blood clots in the human body. For example, the study of the compound cadmium zinc telluride is expected to result in improved radiation detectors, sensors and other electronic products. Dr. David J. Larson of State University of New York at Stony Brook discovered that crystals grown in space without touching the walls of their containers are of markedly higher quality than Earth-grown crystals.

Dr. John Hart of the University of Colorado at Boulder sought to better understand the flows in oceans and the atmospheres of planets and stars in the experiment "Geophysical Fluid Flow Cell." The study showed "banded," rotational patterns of flows, such as those seen in the atmosphere of Jupiter. The observations are expected to be of great importance in understanding weather patterns and climatic conditions on Earth.

Dr. J.J. Favier of the French Center of Nuclear Studies sought to discover how small disturbances in gravity affect the production of alloys and metals. Favier found structural changes resulted during crystal production because of tiny disturbances that occurred when the Space Shuttle's control jets were fired. The study showed fluid flow damage to the crystals could be eliminated when the growing metal's orientation was carefully controlled. This and other findings are expected to improve manufacturing processes for alloys used in airplane-engine turbine blades and electronic materials. They ultimately could bring dramatic improvements in materials manufacturing.

Successful antithrombin crystal growth experiments by Dr. Daniel Carter of NASA's Marshall Space Flight Center made it possible to further define the protein crystal's molecular model and activities in the human body. The crystals, which control blood coagulation in human plasma, are very difficult to grow on Earth because of the forces of gravity.

An experiment by Dr. Robert Gammon of the Institute for Physical Science and Technology at University of Maryland, College Park, demonstrated that physical measurements can be made in the microgravity of space that cannot be done on Earth. This finding provides insight into a variety of physics problems, ranging from state changes in fluids to alterations in the magnetic properties of solids. The results will be valuable in such fields as superconductors and liquid crystals. Gammon studied the behavior of an elemental gas at critical point in the experiment. At critical point, liquid and vapor become one fluid. The fluid collapses under its own weight at critical point on Earth, preventing precise experimentation.

As molten materials solidify during the production of most commercially important metal alloys, they form tiny, pine-tree-shaped crystals called dendrites, which dictate the hardness and integrity of the material. Previous studies indicated that small variations in the growth rate of these patterns in metal were caused by the microgravity environment of space. However, Dr. Martin Glicksman of Rensselaer Polytechnic Institute discovered that variations are controlled instead by the specimen size—contrary to previous conclusions. His findings will lead to the production of less expensive and more reliable cast or welded metal and alloy products.

Dr. Robert Apfel of Yale University has examined the influence of surfactants—substances that alter the surface properties of a liquid. Soap with water is an example of a surfactant-liquid interaction. Apfel's experiment found that surfactants can change the hydrodynamics of droplets. The findings will lead to new and improved technologies in manufacturing cosmetics and synthetic drugs, as well as oil recovery and environmental cleanup.

Dr. Taylor Wang of Vanderbilt University hit droplets with sound. He found that the droplets lost symmetry and began to rotate. The findings from this study promise improved technologies in the chemical processing and pharmaceutical industries and a better understanding of rain formation and weather patterns.

THEIR DISCOVERIES ARE EXPECTED TO LEAD TO BETTER DRUGS, CHEAPER ALLOYS, AND A GREATER UNDERSTANDING OF EARTH.

For more information, contact Steve Roy at the Marshall Space Flight Center. 205/544-0034, 205/544-5852. Please mention you read about it in *Innovation*.

Milk Bottle Blankets "Better Than Wool"

RESCUE BLANKETS MADE OF RECYCLED plastic milk bottles are a new spinoff from NASA's research into the development of lightweight metal insulation for spacecraft, said a collaborator in NASA's Small Business Innovative Research (SBIR) program. Using the same "honeycomb" concept that will be used to make future spacecraft metal heat barriers, researchers working with scientists at NASA Ames Research Center have created a lightweight plastic insulation for blankets and clothing that is "better than wool." Like wool, the new material can also keep a person warm, even when it is wet.

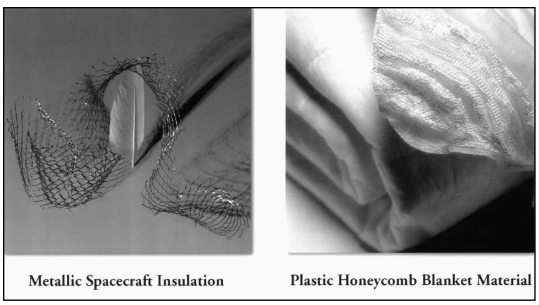
Eventually, about 70,000 of the emergency blankets are expected to be distributed annually by Thermalon Industries, Ltd., of El Segundo, California. Currently, 250 of the blankets are being evaluated for use in emergencies by the Disaster Assistance and Rescue Team at Ames Research Center.

"The blankets are better than wool or fleece because they are nonallergenic, and they dry five times faster. The new material is also four times warmer than wool in cold and damp conditions," said Principal Investigator Steve Miller of S.D. Miller & Associates, Flagstaff, Arizona. "We plan to work with ambulance companies and Red Cross chapters to fully evaluate the use of the blankets."

"During our Phase I contract with NASA, we developed new manufacturing methods for multilayer metal spacecraft insulation," Miller said. The new honeycomb structure we developed is more efficient than fibers for insulation. We'll make honeycomb from metals for high-temperature uses, and we can make plastic insulation, even from recycled milk bottles." If metal honeycomb insulation is used on a future spacecraft, that could significantly reduce launch weight and launch costs, Miller said.

"We believe this could be a breakthrough material for spacecraft insulation," said Dr. Susan White, a materials scientist acting as NASA's technical representative for the SBIR contract with Miller's company.

New manufacturing methods were developed for multi-layer metal spacecraft insulation. The new honeycomb structure is more efficient than fibers for insulation. The honeycomb will be made from metals for high-temperature uses, and plastic insulation can be made from recycled milk bottle plastic.



Metallic Spacecraft Insulation | Plastic Honeycomb Blanket Material

Plastic milk bottles in a recycling center in Silicon Valley near NASA Ames Research Center.

S.D. Miller & Associates recently was awarded a NASA SBIR Phase II, $600,000 two-year contract to collaborate with scientists at Ames and other research institutions to demonstrate insulation efficiency of the new material up to more than 2,000 degrees Fahrenheit.

In keeping with the goals of the SBIR program, the new insulation technology would be commercialized during a Phase III contract without federal government financial support, Miller said. He estimated that 70 jobs to make spacecraft insulation would be created, and the production of rescue blankets might result in 15 jobs.

Students and professors at Northern Arizona University ran thermal tests for Miller's company on various insulation materials. "The SBIR research gave some of our physics and engineering students opportunities to do some real-world research and development and to earn a little extra money, said Andrew P. Odell, a university professor. Further student collaboration is expected during Phase II.

The S.D. Miller & Associates Phase II contract is one of 170 SBIR contracts awarded by NASA. The SBIR program encourages small companies to participate in federal government research and development. SBIR provides seed capital to increase private-sector commercialization of federal research and development innovations.

NASA's Office of Aeronautics and Space Transportation Technology at NASA Headquarters in Washington, D.C., manages the SBIR program. NASA's field centers and Jet Propulsion Laboratory manage the individual SBIR projects. ✿

For more information, contact Dr. Susan White at Ames Research Center. 415/604-6617, *swhite@mail.arc.nasa.gov* Or contact Steve Miller at S.D. Miller & Associates. 520/779-2056, *s.miller@flaglink.com* Please mention you read about it in *Innovation.*

Phase Doppler Particle Analyzer Measures Where Other Devices Cannot

A NEW MEASURING DEVICE AT NASA'S LEWIS Research Center is developing environmentally friendly engines that give off fewer emissions. The Phase Doppler Particle Analyzer (PDPA) can optically determine the size and velocity of spherical particles, such as fuel and water, without interfering with flow. Older measurement techniques required intrusive probes that changed the environment.

Dr. Valerie Lyons at Lewis said a goal in new gas turbine development is to reduce pollutant emissions from the combustor. "If you optimize the mixing of the fuel and air in the combustor, considering fuel drop sizes and velocities and their evaporation rates, you can reduce emission of nitrogen oxides, carbon monoxide and unburned hydrocarbons," she said. "Nitrogen oxides are of particular interest lately because of their capability to react at high altitudes to destroy ozone molecules."

The first PDPA was developed by Aerometrics Inc. of Sunnyvale, California, in 1983 through a Small Business Innovation Research (SBIR) contract with Lewis Research Center. The system consists of a laser and an optical system, which transmits the laser beam into the flow to be measured, then receives scattered laser light from the flow and interprets the size and velocity data using a personal computer with custom software.

Greg Payne, Aerometrics technical support engineer, said, "Since the PDPA is an optical technique, it can be used in areas where other measuring tools cannot. The Phase Doppler Particle Analyzer can be used anywhere someone needs to measure small, round particles, like in fuel injection systems, medical nebulizers and bubbles in water."

Mark Klem of NASA Lewis said the PDPA "can measure the drop size in sprays. You have to know the drop size to determine how long combustion will occur: When the droplet burns up, combustion is over."

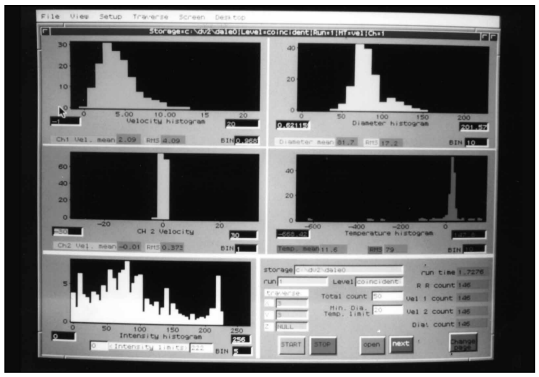
How can the Phase Doppler do all of this and not get in the way? According to Aerometrics, the PDPA method is based on light scattering interferometry. Measurements are made in a small, nonintrusive optical probe volume defined by the intersection of two laser beams. As particles pass through the probe volume, they scatter light from the beams and create an interference fringe pattern. A receiving lens at an off-axis collection angle projects part of this fringe pattern onto detectors, which produce a Doppler burst signal with a frequency proportional to the particle velocity. The phase shift between the Doppler burst signals from the different detectors is proportional to the size of the spherical particles.

Left: Aerometrics Inc. developed the Phase Doppler Particle Analyzer via a contract with Lewis Research Center. The system consists of a laser and an optical system.

Below: It receives scattered laser light from the flow.

This development by Aerometrics can measure particle size and velocity simultaneously in the probe volume. It requires no calibration because the particle size and velocity depend only on the laser wavelength and optical pattern. ✿

For more information on the Phase Doppler Particle Analyzer, contact Greg Payne at Aerometrics, Inc. 408-738-6688. Or contact Dr. Valerie Lyons at the Lewis Research Center. 216-433-5728. Or contact Mark Klem at Lewis. 216- 977-7473. Please mention you read about it in *Innovation*.



Customized computer software interprets data on size and velocity of scattered laser light received via the optical system.

NASA Partners With Small Business for New Space Science Initiative

NASA and 10 small companies are working together to generate many of the innovations that will make space interferometry a reality.

NASA awarded Phase I Small Business Innovation Research (SBIR) research and development contracts in interferometry to establish the feasibility of the companies' proposed innovations (see the box below). Successful Phase I contractors will compete for Phase II contracts to develop these innovations. These companies will work the Interferometry Program at Jet Propulsion Laboratory to develop their innovations for future space interferometry missions.

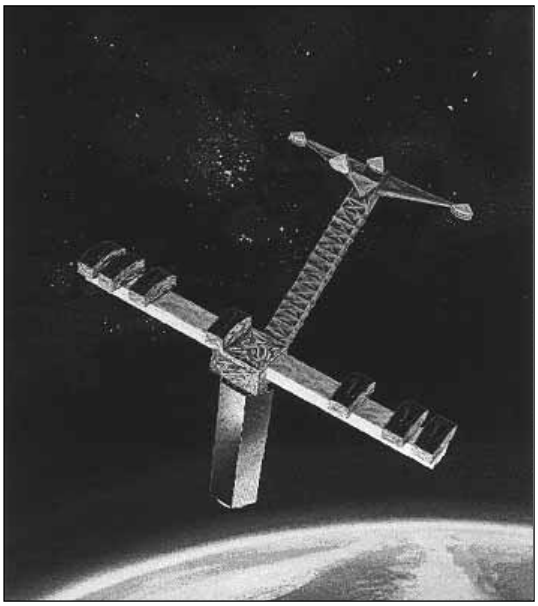
Space interferometry will more accurately measure the distance to stars, generate higher resolution images and, for the first time, see planets around another sun or star. The first planned Space Interferometry Mission (SIM) will measure the location of stars with an accuracy comparable to measuring the thickness of a quarter on the Moon.

Space interferometers use more than one mirror to collect light from stellar objects. This multi-use of mirrors overcomes the limitations of current launch systems, which keep mirror size to approximately three meters. The distance light travels from separate mirrors must be the same for the light to be successfully combined into an image. This extremely demanding requirement means mirror location must be accurate to approximately tens of nanometers; otherwise, each mirror's light waves cancel each other rather than build a stronger image.

Space interferometers take advantage of this nulling effect. Light from locations other than the interferometer's focus hits the mirror at various distances, canceling each other out. Thus, a star's blinding light can be canceled by the nulling effect. Astronomers then can see much fainter objects, such as planets around stars and a planet in another solar system.

SBIR PHASE I INTERFEROMETRY PROJECTS

Company	Proposed Innovation
Digital Optics Corporation	An optical encoder to precisely sense the location of segmented mirror elements
Garman Systems	A solid-state electric actuator for vibration isolation and attenuation
Intelligent Automation Inc.	A passive damping system that does not require power controls
Meadowlark Optics	A liquid beam steerer to align accurately laser beams for precise distant measurement (metrology)
Pixel Vision	A 20,000-frame-per-second light sensor for capturing the laser light signal
Payload Systems	A low-cost nanometer accuracy measurement system to deploy the elements on an interferometer
Schwartz Electro-Optics	An ultra-stable, solid-state laser suitable for precision metrology
SciMeasure	A sensitive high-frame-rate, solid-state camera for image generation
Vibro-Acoustic Sciences	An integrated engineering design method for investigating the structural dynamics at the nanometer level of complex systems, such as a space interferometer
Xinetics	A deformable mirror for fine-tuning the image captured by mirrors



Artist's conception of a 10-meter baseline SIM spacecraft in Earth orbit that will measure the positions of stars in the sky and their distances with a precision that far exceeds ground observations.

SIM is the first of several planned space interferometry missions. It will provide more accurate information on the location of stars and evidence of the existence of planets around stars other than our Sun. ✸

For more information, contact Patricia A. McGuire at Jet Propulsion Laboratory. 818/354-1258, 818/354-2385, *patricia.a.mcguire@jpl.nasa.gov* Please mention you read about it in *Innovation.*

NASA SBIR Phase I Proposals Selected

NASA HAS ANNOUNCED THAT 349 RESEARCH proposals have been selected for immediate negotiation of Phase I contracts for NASA's 1996 Small Business Innovation Research (SBIR) program. The current solicitation closed in August 1996. It prompted 2,367 proposals submitted by small, high-technology businesses from across the United States. The estimated combined award total for the 349 Phase I contracts is $24 million.

The SBIR program seeks proposals directed at specific NASA needs. SBIR proposals are focused on meeting NASA mission requirements and further developing the proposed technology into commercial products and services. The SBIR program objectives are to stimulate U.S. technological innovation by using small businesses, including minority and disadvantaged firms, to meet federal government research and development needs and to encourage commercial applications of federally supported research innovations.

Nine NASA field centers, Jet Propulsion Laboratory and NASA Headquarters reviewed proposals for technical merit, feasibility and relevance to NASA research or technology requirements. The selected firms will be awarded fixed-price contracts valued at up to $70,000 each to perform a six-month Phase I feasibility study.

Companies successfully completing 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 at an amount up to $600,000. ✸

The list of companies selected for NASA SBIR may be accessed on the Internet at: *http://nctn.hq.nasa.gov/nctn/SBIR/SBIR.html* Please mention you read about it in *Innovation.*

INFLUENZA DRUG RESULTS FROM SHUTTLE RESEARCH

Microgravity research performed aboard NASA's Space Shuttles could help prevent influenza. It could also increase the supply of potatoes for McDonald's french fries.

"Protein crystals grown in space have resulted in a drug currently being tested by the U.S. Food and Drug Administration that will control the spread of influenza in humans," Ed Gabris, director of NASA's Space Processing Division, said on January 27. "The protein was actually being grown on Earth, but the space flight opportunity provided a way to grow it faster and to accelerate the development of the drug," Gabris said. If clinical trials are successful, the drug is expected to be on the market in 2004.

McDonald's Corporation, one of the world's largest consumers of potatoes, also is collaborating with NASA microgravity researchers to find a way to enhance the ability for potatoes to withstand extreme frost and high winds. ✸

Source: *Space News* (February 1997)

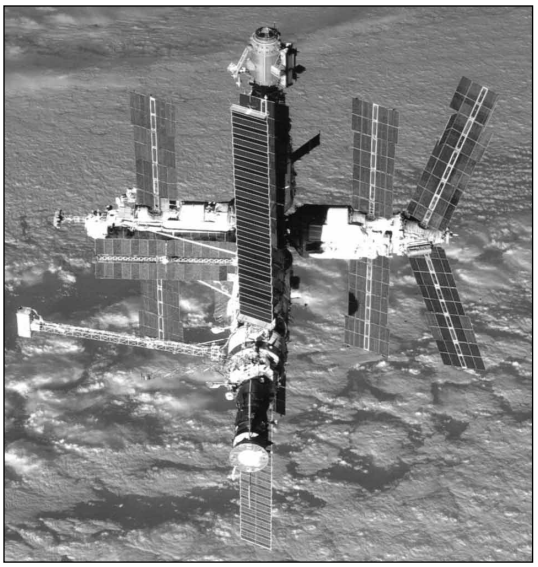
Mir Teamwork Transcends Geography, Language and Culture

A TEAM OF U.S. AND RUSSIAN INDUSTRY AND government researchers led by NASA developed, manufactured, tested and delivered the *Mir* Cooperative Solar Array (MCSA) in record time and under budget. This goal was accomplished despite geographical obstacles and cultural and language differences that made a project of this size and complexity that much more complex.

MCSA augments *Mir*'s power system. The power from this flight solar array extends *Mir*'s life and supports U.S. experiments on the station as part of the Phase I International Space Station program. MCSA was launched on the Space Shuttle *Atlantis* (STS-74) in November 1995, and it was deployed and became operational in May 1996, less than one and a half years after the project's inception in January 1994. It is generating six kilowatts of electricity on *Mir*.

Researchers developed MCSA by replacing an existing degraded array with a new U.S.-Russian jointly developed array that combined Russian flight-proven structures designed by the Rocket Space Corporation–Energia and mechanisms with U.S. higher performance photovoltaic panel modules (PPMs) produced by Lockheed-Martin. The MCSA Integrated Product Team was led by NASA's Lewis Research Center for the Space Station Program Office. Team members were from Rocketdyne, Lockheed-Martin and Rocket Space Corporation–Energia.

Below: STS-71—A Mir *cosmonaut and a Shuttle astronaut exchange a historic handshake in space.*



This dramatic image was taken from Atlantis *after undocking from* Mir *near the end of the STS-79 mission. The MCSA is seen vertically in the center of the image.*

The team's greatest challenge was meeting project milestones. U.S. and Russian hardware delivery schedules were extremely tight. U.S. flight hardware had to be delivered to Russia in less than one year, and the Russians were required to assemble, test and ship MCSA to Kennedy Space Center six months after receiving U.S. flight PPMs.

The team operated independently to the extent possible under the Phase I International Space Station program. It generated and managed its own interface documentation and shipment of hardware to Russia and jointly developed a success-oriented plan to meet the demanding schedule.

U.S. flight hardware manufacturing began before the completion of the development tests in Moscow. The array qualification tests had to be conducted in parallel with the flight hardware acceptance tests.

Problems did arise, but they were handled by the team expeditiously and at minimal cost or schedule impact. For example, the team identified the necessity for PPM mass-stiffness simulators four months prior to their need date. The team located discarded solar cells from other projects, and the U.S. team manufactured and delivered nonfunctional, flight-like PPMs under cost and on schedule.

For more information, contact Mike Skor at Lewis Research Center. 216/433-2286, *m.skor@lerc.nasa.gov* Please mention you read about it in *Innovation.*

NASA Accepts Vice President's Challenge to Reduce Aircraft Accidents

NASA HAS COMMITTED $500 MILLION OVER the next five years to find ways to reduce aircraft accidents. NASA, in partnership with the federal Aviation Administration (FAA), the Department of Defense (DOD) and the aviation industry, has accepted the challenge of the White House Commission on Aviation Safety and Security. The commission asked NASA, the FAA, DOD and the aviation industry to reduce aircraft accidents five-fold over the next 10 years.

The initiative includes research to reduce human-error-caused accidents, predict and prevent mechanical and software malfunctions and eliminate accidents involving hazardous weather and controlled flight into terrain. DOD is assisting in defining requirements and actions to implement many of the safety standards.

NASA Administrator Daniel S. Goldin said, "We're looking for solutions that will save lives. NASA is prepared to step up to the national goal set by the Vice President's commission without requesting additional funds. This partnership will lead to breakthroughs that will achieve a safer tomorrow in aviation." The $500 million commitment will originate from reprogramming existing aeronautics funds, in addition to reassigning people and NASA facilities' work.

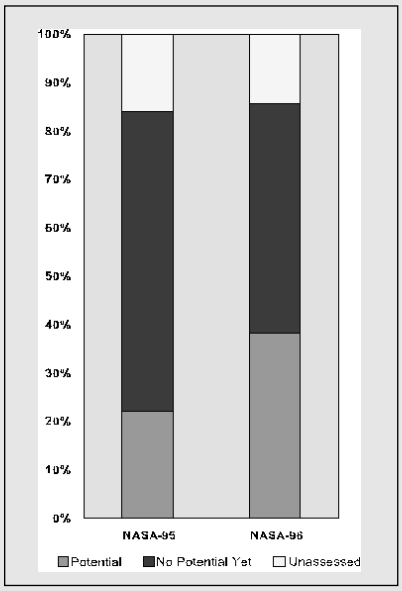
Acting FAA Administrator Barry Valentine said, "The FAA and NASA have a proud history of working together to make the U.S. aviation system the safest and most efficient in the world. Our two agencies, along with our industry partners, are going to take this research investment and turn it into improvements that will benefit all aviation users."

The FAA has a diverse aviation safety research effort that ranges from basic studies on the airworthiness of materials to the development of new products for safety inspectors, security inspectors and air traffic controllers. Last year, the FAA unveiled the Global Analysis and Aviation Network (GAIN), an unprecedented concept to help reduce accident rates. GAIN collects and analyzes worldwide aviation safety data to spot safety-related trends, then shares the analysis with the global aviation community.

Significant accomplishments in aircraft safety have been made over the years, thanks to NASA, the FAA and industry partners. Some examples include providing technology for the advanced warning of wind shear, developing evaluation methods and analyses to help ensure that older aircraft are as structurally sound as new ones, improving the control of general aviation aircraft stall and spin and developing advanced ice-detection concepts to improve aircraft operations. ✸

For more information, contact Charlie Huettner at NASA Headquarters. 202/358-4703, 202/358-4066. Please mention you read about it in *Innovation.*

NASA COMMERCIAL TECHNOLOGY PROGRAM



MEASURES AND METRICS

In fiscal year 1995, NASA began a systematic, agencywide process to identify those programs with commercial potential—that is, the potential to yield an innovation that could result in commercial application and benefit. This inventory allows technology transfer and commercialization to be more proactive and better focus its limited resources.

From fiscal year 1995 to fiscal year 1996, NASA identified an additional 16 percent (from 22 percent to 38 percent) of its programs with commercial potential. This represents a 73-percent increase over fiscal year 1995. The programs identified as having commercial potential represent a fiscal year 1996 NASA investment of $4.7 billion. To date, these programs have produced 4,726 individual innovations that may result in commercial applications and benefits. ✸

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 or office listed. Please mention you read about it in* ***Innovation.***

Design and Engineering

Elastic Properties Ultrasonic NDE System for Composite Materials (EPUN)

Jet Propulsion Laboratory (JPL) seeks to transfer EPUN, a nondestructive evaluation technology that uses a modified version of a C-scan attachment, to analyze and map the material stiffness constants of composite structures to determine their material quality, integrity and mechanical performance. EPUN was designed to measure a composite laminate's fiber, resin and interface characteristics, to cure process and hosted defects by using platewaves analysis and to determine ultrasonic dispersion data. The method can be used to obtain improved estimates of porosity and resin content volume fraction. EPUN could be used commercially to inspect composite structures for the presence of defects because it reduces the need for costly mechanical tests. ✲

For more information, contact: Dr. James Rooney, Technology Transfer and Commercialization Office, Jet Propulsion Laboratory, 818/354-2503.

Productivity Enhancement Complex

The Materials and Processes Laboratory at Marshall Space Flight Center operates the Productivity Enhancement Complex (PEC). At this complex, NASA and industry work together to develop new materials, processes and assembly techniques. The PEC is the focal point for cooperative research activities between Marshall and its contractors. These partnership efforts provide valuable benefits, such as the reduction of program costs, the promotion and exchange of new ideas and the validation of new materials and processes. With more than 40 research areas, the PEC can accommodate a variety of activities, such as creating or modifying computer programs for industrial robots used in welding processes, manufacturing cutting-edge composite materials, designing vacuum plasma spray techniques and providing rapid prototyping and cryogenic insulation development. NASA encourages collaboration efforts between NASA and industry to develop advanced manufacturing techniques. ✲

For more information, contact: Technology Transfer Office, Marshall Space Flight Center, 800/USA-NASA.

Continuously Variable Planetary Transmission

The NASA-designed Continuously Variable Planetary Transmission technology improves vehicle acceleration and engine speed as it smoothly transmits torque from an engine to a drive-shaft independent of engine speed. This fuel-efficient technology developed at Goddard Space Flight Center could be applied to transportation vehicles, agricultural equipment and machinery with power transmissions that must adapt continuously to their power requirements. The technology has a simple compact design with few linkages and synchronizing gears; it provides forward, neutral and reverse directions with fingertip control and changes gear ratios under load with no clutch. ✲

For more information, contact: Office of Commercial Programs, Goddard Space Flight Center, 301/286-5169.

High-Temperature Thin Film Strain Gauges

Lewis Research Center developed the thin film strain gauge to measure stress of advanced materials in aeronautic and aerospace research with minimal aerodynamic effects and at much higher temperatures than similar gauges already on the market. The high-temperature gauge is vacuum-deposited thin film placed directly on the structure it is measuring. Because it can measure dynamic and static strain up to 1,100 degrees Celsius, tests of many advanced materials can be done in harsh environments at extremely high temperatures. The gauge is highly stable and repeatable and can be produced at low cost. The sensors will be extremely useful in designing high-speed civil transport vehicles and gas turbine engines, in measuring crack development and propagation, stress distribution and the thermal expansion coefficient of materials at very high temperatures, and in designing new and advanced materials for use in extremely high-temperature environments. ✲

For more information, contact: Anne Heyward, Commercial Technology Office, Lewis Research Center, 216/433-5568.

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.

Bruce Webbon
Ames Research Center
Moffett Field, California 94035-1000
415/604-6646
bwebbon@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
805/258-3802
duke@louie.dfrc.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
Goddard Space Flight Center
Greenbelt, Maryland 20771
301/286-5810
george.e.alcorn.1@gsfc.nasa.gov

Jet Propulsion Laboratory
Selected technological strengths are Near/Deep-Space Mission Engineering, Microspacecraft, Space Communications, Information Systems, Remote Sensing and Robotics.

Merle McKenzie
Jet Propulsion Laboratory
Pasadena, California 91109
818/354-2577
merle.mckenzie@ccmail.jpl.nasa.gov

Johnson Space Center
Selected technological strengths are Artificial Intelligence and Human Computer Interface, Life Sciences, Human Space Flight Operations, Avionics, Sensors and Communications.

Henry (Hank) Davis
Johnson Space Center
Houston, Texas 77058
713/483-0474
henry.l.davis@jsc.nasa.gov

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

Gale Allen
Kennedy Space Center
Kennedy Space Center,
Florida 32899
407/867-8035
gale.allen-1@kmail.ksc.nasa.gov

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

Joe Heyman
Langley Research Center
Hampton, Virginia 23665-5225
757/864-6005
j.s.heyman@larc.nasa.gov

Lewis Research Center
Selected technological strengths are Aeropropulsion, Communications, Energy Technology and High Temperature Materials Research.

Ann Heyward
Lewis Research Center
Cleveland, Ohio 44135
216/433-3484
ann.o.heyward@lerc.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.

Harry Craft
Marshall Space Flight Center
Huntsville, Alabama 35812
205/544-5419
harry.craft@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
601/688-1929
ksharp@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
408/260-6566

Dan Morrison
Mississippi Enterprise for Technology
Stennis Space Center, MS
601/688-3144

Dianne Rucki
Lewis Incubator for Technology
Cleveland, OH
216/229-9445

Maria Clark
Florida/NASA Business Incubation Center
Titusville, FL
407/383-5200

Small Business Programs

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

Paul Mexcur
Goddard Space Flight Center
Small Business Innovation Research Program (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
Massachusetts Technology Park
508/870-0042

J. Ronald Thornton
Southern Technology Applications Center
University of Florida
904/462-3913

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
216/734-0094

David Moran
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 ON-LINE

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.

MOVING FORWARD

Awards

Langley Research Center received the ***Federal Laboratory Consortium's*** award for excellence in technology transfer. During the dedication of a new building for Technico Incorporated, Congressman Sisisky's (D-VA) remarks recognized NASA's contributions in technology transfer. Technico's product line for this new building includes rubber technology expansion, generated from Langley's Technology Opportunities Showcase (TOPS). ✿

Events

NASA's Lewis Research Center in Cleveland hosted a ***"Partnering Opportunities for Small Businesses"*** workshop on April 24, 1997. The workshop was presented by the US Air Force's Small Business Innovation Research (SBIR) Program, the Lewis SBIR Office and the Ohio Department of Development. Presentations were given by the Air Force, Lewis and the State of Ohio. Small businesses learned about partnering opportunities with large companies and universities. Other topics discussed were technology transfer, commercialization and intellectual properties. If you missed this conference, a similar one will be held in the Dayton, Ohio, area on August 7, 1997. For additional information and other inquiries, contact ✆ 800/848-1300, ext. 3887, or ✆ 614/466-3887, 🖷 614/644-5758, ✉ *ohsbir@odod.ohio.gov* ✿

Multi-Media

Go to the on-line ***NASA Commercial Technology Network*** at *http://nctn.hq.nasa.gov* to view and download the network's free screen saver. While visiting, follow the link to the web edition of *Spinoff '96*—an annual publication that highlights products and services made possible by NASA technology. Print copies of *Spinoff '96* may also be obtained by calling the National Technology Transfer Center at ✆ 800/678-6882.

The ***Detector Development Laboratory (DDL)*** at Goddard Space Flight Center in Greenbelt, Maryland, is a highly advanced semiconductor fabrication facility that meets all the latest federal and state safety codes and regulations. RTI has developed for Goddard a virtual tour of the DDL facility, available on CD–ROM for Windows 95 and Macintosh systems. The tour allows interested companies to explore the lab and determine the fit with company needs and goals. The CD–ROM and Goddard facility and capability brochures are available upon request. For more information on NASA Goddard's DDL, contact Glenn Unger, ✆ 301/286-5979, 🖷 301/286-1717, ✉ *glenn.l.unger.1@gsfc.nasa.gov.homepage* ✿

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Space Administration

Office of Aeronautics and Space
Transportation Technology, Code R
Washington, DC 20546-0001

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