SCIENCE INFORMATION SYSTEMS NEWSLETTER

NASA

Office of Space Science

Science Information Systems Program

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Welcome to Issue 47

1998

The Applied Information Systems Research Program (AISRP) maintains an awareness of emerging technologies applicable to space science disciplines, supports applied research in computer and information systems science and technology to enhance NASA Office of Space Science (OSS) programs, stimulates application development where warranted, and provides for the systems analysis and engineering required to transfer new technology into evolving OSS space science programs through NASA Research Announcements.

Stereoscopic Visualization and Analysis of Space Science Observations and Simulations

D. Aaron Roberts, Laboratory for Extraterrestrial Physics, Goddard Space Flight Center

New methods for true 3D visualization using "glyphs" and a hand tracker interface, in addition to traditional methods, will provide scientists desktop access to powerful new ways of visualizing data. Target data sets for these new methods include MHD and other simulations, multi-spacecraft time series visualized in their actual relative locations (see magnetic field vectors below), and astrophysical data sets such as 3D galaxy positions.

The 3D world

A 3D world is best explored with 3D input devices. In addition to investigating new devices, new software is being developed to take advantage of a pair of magnetic hand trackers equipped with three buttons each. Pan, zoom, and rotate all become one natural motion, and selecting 3D subsets becomes similar to using a mouse in 2D.

Figure 1. Exploring with 3D devices

The main focus for the user interface is the use of liquid crystal glasses that allow viewing of left and right eye rendering alternately to produce the stereo, and in which two hand held sensors allow the rendered volume to be rotated, panned, zoomed, subsetted, etc. The sensors will have buttons with which to select various functions. For example, one sensor, when selected, will display "sundial" menus, which allow you to perform functions such as loading files or rescaling glyphs without leaving the stereo environment.

Visualing vectors

Vectors are especially difficult to visualize in 2D. Typically, interplanetary magnetic field vectors are represented by a series of plots for the components. The representation below shows a very different view, and one that is greatly enhanced by stereo (this is a parallel stereo pair). Note also that the color of the vectors represents temperature, and the symbols on the axis indicate the density.
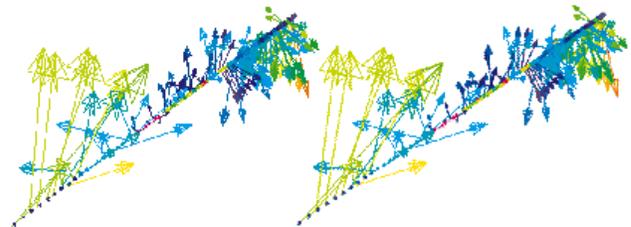
Figure 2. Time series of magnetic field vectors

This figure shows a time series of magnetic field vectors near a "sector boundary" where the field reverses, colored by the local temperature and with density given by the colors on the axis. The (parallel) stereo gives a totally different view of the data from the traditional line plots. Data from many spacecraft could be displayed in the 3D location it was measured, to reveal global connections in a direct way. Data measured at many points may be subsetted according to various criteria to search for patterns not otherwise readily discerned.

Using "glyphs"

The use of "glyphs" or symbols at each point provides an efficient way of representing information about a quantity throughout a volume. With stereo, the 3D position of the glyphs is readily perceived, making it possible to see into the

volume without the use of, for example, nested isosurfaces or time consuming volume visualization. (These methods are still useful, and will be implemented as well). Information can be in the size, color, shape, orientation, opacity, or other properties of the glyphs. Shown in the data representation below, the spheres size and color represent the magnitude of the quantity, cones oriented along a vector direction with the color giving the magnitude, and arrows showing vectors colored by magnitude. Many other possibilities exist and experimentation is being done to maximize information content and efficiency.
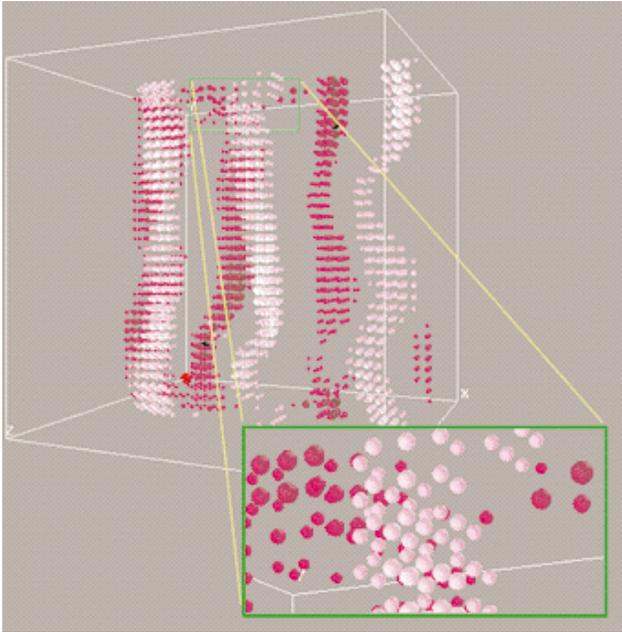
Figure 3. Representing the magnitude of the quantity

Conclusion

Stereo allows the visualization of complex data. The addition of the third dimension allows a greater information density on the screen, as well as the use of meshes and glyphs that are incomprehensible without the depth. Other methods, such as volume rendering, are quite useful but time consuming.

To learn more about this research, email Aaron Roberts at <aaron.roberts@gsfc.nasa.gov>

Acknowledgements

CD-ROM Provides a 3D Tour of the Solar System

Brian Anderson, Publications and Program Services Department, Lunar and Planetary Institute

DR. SCHENK'S AMAZING 3-D SOLAR SYSTEM

"It gives you a very different perspective on what other planets look like. One can actually sense how rugged the mountains are and how deep the craters are".

Just as invention is often born of necessity, the 3D Tour of the Solar System sprang from the seed of one man's frustration with a specific scientific problem.

I wanted to know how deep the craters were on the icy satellites," said Paul Schenk, the senior author of the CD-ROM recently released by the Lunar and Planetary Institute. "The methods that were available were kind of primitive, and I thought it would be a real big help if we had stereo images so I could measure the features directly.

Soon afterward, Schenk came across some stereo images of Uranus' satellite Miranda and realized a valuable scientific resource may have remained untapped.

"I began to investigate whether there were any unused stereo images in the Voyager dataset," Schenk said. "I found out that most of the outer planets had stereo coverage, which surprised me. Once I had that, it was natural to extend it to the rest of the solar system."

After discovering a wealth of viable stereo images, Schenk and co-authors David Gwynn and James Tutor began the arduous process of sifting through the datasets of various missions to select representative images of the nine planets, t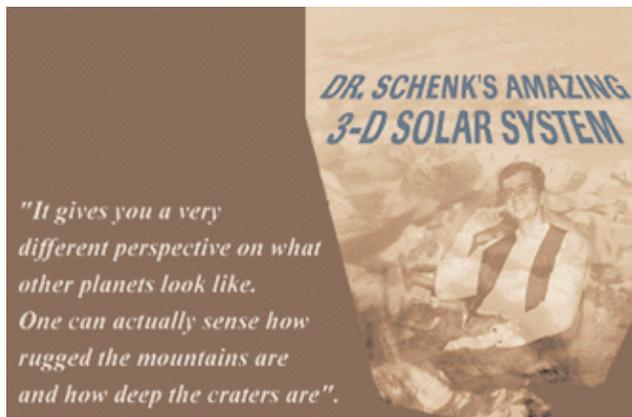heir satellites, and the asteroid belt. Most of the stereo pairs, save for some dedicated stereo images taken on Apollo and Magellan missions, had to be constructed using existing orbital photographs.

"I think this has been the first chance anybody has had to explore these images," Schenk said. "A few people had looked at a few examples, such as Miranda, but I think a lot of people just assumed there was no useful stereo coverage."

Over a period of about a year, Schenk and his coworkers processed, cleaned up, and reprojected the selected original images to create optimum stereo pairs. ("Your mind would just explode if you saw the originals," Schenk explained.) In addition, for many of the images, the scientists compiled data sheets of relevant factors such as spacecraft altitude, image width, and stereo baseline.

"We were all surprised by the amount of work that was involved," Schenk said.

From left to right, James Tutor, David Gwynn, and Paul Schenk.

Paul Schenk observes as participants at the 28th Lunar and Planetary Science Conference explore the Solar System in 3D.

The resulting product, the first collection of true stereo images from the solar system, contains more than 150 images. The images are viewed using red-green 3D glasses (included with the CD) and highlight important geological features such as impact craters, volcanos, and faults, in keeping with Schenk's original focus.

"It gives you a very different perspective on what other planets look like. One can actually sense how rugged the mountains are and how deep the craters are," Schenk said. "We tried to put in several examples of all the prominent features on planets. It's a useful way of illustrating specific geological features and the deposits and structures that are associated with them."

Some of the stereo pairs reveal dramatic geological features not visible in standard photographic images. Many of the volcanos on the outer satellites turned out to be flatter than expected, for example, and images of Ra Patera on Io revealed a connection between a lava flow and a high plateau east of the volcano.

"This wasn't detected at all with the standard images," Schenk said.

Although 3D vision in one sense emulates the depth perception of human eyesight, the stereo images on the 3D Tour are exaggerated to show vertical relief and geological detail. Whereas human eyes are separated by only a few inches, Schenk tried to select images that were spaced apart at distances equal to or greater than the altitude at which they were taken. Essentially, these images give a Paul Schenk observes as participants at the 28th Lunar and Planetary Science Conference explore the solar system in 3D. "giant's eye" view of terrain, revealing features in striking stereo detail that would not be apparent in normal orbital views.

"If you were in orbit, you wouldn't be able to tell anything about these features," Schenk said.

Schenk, who earned a Ph.D. in planetary sciences in 1988 and joined LPI's scientific staff in 1991, notes that geologists have long relied on stereo images for gauging distances on Earth and that NASA continues to use the technology for navigational purposes in rover operations such as Pathfinder. He believes stereo imaging will play an increasingly important role in studying the icy satellites and Mars, and he hopes to focus his own research in that direction.

"I plan to use the stereo images to actually map the topography of the icy satellites, which hasn't been done, focusing on Io and Ganymede. Those are the first on the list, then Mars. Some of this has been done on Mars, but it hasn't been done everywhere."

In addition to pursuing his own research interests in the coming years, Schenk will oversee the production of future editions of the 3D CD-ROM, including an interactive multimedia version for younger audiences that is already in the works.

"I definitely have plans to do more such products and to make them bigger and better," Schenk said.

Brian Anderson recently assumed editorship of the LPI publication

Learn more about the 3D Tour of the Solar System CD-ROM and the Lunar and Planetary Institute by accessing the Tour and LPI <http://cass.jsc.nasa.gov/lpi.html>. ■

Netamorphosis -

Demonstrating Cutting Edge Networking Capabilities

This March advanced networking and cutting-edge applications, developed by the Next Generation Internet (NGI) research and development initiative, were demonstrated at "Netamorphosis," an event that brought together Federal Agencies, Congressional, and private sector representatives. In cooperation with Highway 1 and the High Performance Computing and Communications Consortium, representatives from the White House, seven Federal agencies, academia, and industry showed members of Congress how further development of NGI technologies will lead to advancements in health care, the environment, manufacturing, defense, and education.

Announced by President Clinton in October, 1996, and mentioned in the President's recent State of the Union address, the NGI Initiative is part of the ongoing, multiagency, Federal research and development (R&D) program in Computing, Information, and Communications (CIC). Its goals are to conduct R&D in advanced networking technologies, to create revolutionary applications like those showcased today, and to demonstrate those capabilities on testbeds that are 100 to 1,000 times faster end-to-end than today's Internet.

"President Clinton's Next Generation Internet initiative will speed the development of far more powerful and more versatile networking and information technologies for the 21st century," said John H. Gibbons, assistant to the President for Science and Technology. "NGI will foster dynamic partnerships among industry, universities, and government that not only will ensure our continued leadership in advanced computing and communications technologies, but that will also drive the creation of new high-wage jobs, new market opportunities, and new multimedia services for our homes, schools, and businesses."

For example, researchers at the University of Oklahoma, with Federal funding from the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the Federal Aviation Administration (FAA), have developed a prototype numerical weather prediction system to forecast intense small-scale spring and winter storms up to several hours in advance. In some cases, the system can pinpoint their locations within one or two counties.

"This new technology has the potential to save lives and millions of dollars in weather-related revenues lost each year in commercial aviation, agriculture, surface transportation, power and communications utilities, and recreation," said Kelvin Droegemeier, director of the OU Center for Analysis and Prediction ofStorms (CAPS). "In forecast-

ing, speed is the name of the game. Unfortunately, current limited network capacities prevent CAPS from providing all available data to forecasters and other end-users in a timely manner. We need about a factor of 100 more bandwidth, and it is just not available right now. This is where the NGI Initiative will provide a valuable service."

The Netamorphosis demonstrations were developed by seven Federal agencies: (Defense Advanced Research Projects Agency DARPA), Department of Energy (DoE), National Aeronautics and Space Administration (NASA), National Institutes of Health (NIH), National Institute of Standards and Technology (NIST), National Oceanic and Atmospheric Administration (NOAA), and National Science Foundation (NSF). The demonstrations were made possible by a state-of-the-art networking system installed for the event, but all applications require further advancements in networking technologies to make them fully functional, widely available, and affordable. Demonstrations included:

- SF Express - an interactive military training tool integrating data on weather, terrain, land, sea, and air assets, and other strategic factors to create simulated battle environments. (DARPA)
- Drug Design Collaboratory - a "collaborative laboratory" allowing scientists in distant locations to study the molecular structure of biomaterials and design effective medicines. (NIH)
- Octahedral Hexapod - an experimental metal-cutting machine tool controlled remotely by software rather than manual manipulation. The first major departure in machine tool design in more than a century. (NIST)
- Interactive Echocardiography - a telemedicine application allowing cardiologists to examine cardiac structure and cardiovascular blood flow in patients located elsewhere, even in space. (NASA)
- Materials Microcharacterization Collaboratory - links five national laboratories and gives researchers access to state-of-the-art instruments for studying the structure and composition of metals, ceramics, alloys, and other materials to determine qualities such as strength, fracture toughness, and corrosion and wear resistance. (DoE, NIST)

Netamorphosis was held at Highway1, a non-profit organization dedicated to educating Congress about technology, and was hosted by the White House Office of Science and Technology Policy and the White House National Economic Council. The National Coordination Office for Computing, Information, and Communications, Highway 1, and the High

Performance Computing and Communications Consortium sponsored the event, with support and technical contributions provided by Bell Atlantic, Cisco, Highway1, IBM, Internet2/University Corporation for Advanced Internet Development (UCAID), and MCI.

Learn more about the Federal NGI Initiative and Netamorphosis or the National Coordination Office for Computing, Information, and Communications by accessing NGI at <http://www.ngi.gov> or NCO at <http://www.ccic.gov/>. ∎

Supporting El Nino Studies With One of the World's Most Powerful Supercomputers

Cynthia O'Carroll, Public Affairs Specialist, and Jarrett Cohen, Science Writer, Goddard Space Flight Center

NASA's Seasonal to Interannual Prediction Project (NSIPP) will use an upgraded CRAY T3E-600 supercomputer at Goddard Space Flight Center (GSFC) to support scientific and computational efforts to predict seasonal to interannual climate variations. The augmented CRAY T3E will enable NSIPP to run models capable of predicting phenomena such as El Nino and its associated atmospheric effects felt in many regions around the globe.

The NSIPP and a science team of investigators from universities and other institutions will have access to 512 new processors in the upgraded CRAY supercomputer at Goddard. The total system of 1,024 processors, 131 billion bytes of memory and 1.2 trillion bytes of online disk space will perform nearly 400 billion floating-point operations per second (400 gigaflops) on a standard benchmark, ranking it among the world's five most powerful supercomputers.

Goddard's CRAY T3E can do in one second what would take every person in the United States using hand-held calculators over 40 years to perform.

"We plan to enhance these computational capabilities in support of our Earth Science objectives and establish Goddard as the lead center for Earth science supercomputing internationally," said Dr. Ghassem Asrar, NASA Associate Administrator for Earth Science. "The challenge is to implement large-scale Earth system models, run them in a timely fashion and then transfer the technology to the operational agencies such as the National Oceanic and Atmospheric Administration."

NSIPP scientists will combine comprehensive satellite observations with global climate models. Since the ocean, with its large heat capacity, contains the memory of short-term climate variability, the project will build a new ocean data assimilation system to ingest the satellite data and provide the initial conditions for predictive model runs. Experimental predictions using past El Nino events for verification will assess the ability to forecast future events.

"The new technology will enable us to develop the best system-coupled climate models and data assimilation system-for taking full advantage of NASA's satellite observations for this problem," said Dr. Michele Rienecker, NSIPP's principal investigator. "We will be able to conduct ensembles of runs to give a realistic statistical characterization of uncertainty in the forecasts." NSIPP has developed a global general circulation model that couples models of the oceans, atmosphere, land surface and sea ice. The parallel model, capable of running on many computer processors, is a product of research funded by the Earth and Space Sciences Project of NASA's High Performance Computing and Communications Program.

"This system upgrade can be seen as an Agency commitment to scaleable parallel computing for operational supercomputing," said Lee Holcomb, NASA Chief Information Officer. "It culminates more than 20 years of NASA investment in parallel computing technology development."

Climate models divide the globe into a grid of layered columns, solving the relevant equations in each column layer and then assembling the full results. With 512 processors, NSIPP will be able to use a finer grid resolution than possible so far, with a column 1/2-degree wide (or 30 miles over the continental United States) in the atmosphere model, for example.

"We know that model resolution impacts the ability to simulate the ocean as well as the atmosphere and land surface in a realistic manner," Rienecker said.

The CRAY T3E upgrade is occurring in two stages, with 384 processors installed in March and 128 processors scheduled for availability in May. A next-generation parallel supercomputer is planned for the year 2000.

Learn more about NSIPP and the Earth and Space Sciences Project by accessing the NSIPP website at <http://nsipp.gsfc.nasa.gov/servlets/Nsipp?source=main.html> or ESS at <http://esdcd.gsfc.nasa.gov/ESS/>. ∎

Spacelink -

NASA's First Public Online Resource Marks Tenth Anniversary

In the mid 1980s, long before the world was barreling down the "Information superhighway," a group of pioneers at Marshall Space Flight Center (MSFC) was mapping a new route, called Spacelink, for taking NASA resources to the public. Spacelink, NASA's first public online information resource, recently celebrated its tenth year anniversary.

When Spacelink first began, the only way to access NASA information online was by using a modem and dialing direct to MSFC. As computer technology and online services underwent sweeping changes through the years, Spacelink was redesigned four times to keep pace with the technological advances.

"As Internet popularity began to grow, we knew teachers would begin using it to gather information, so that was the next step," said Jeff Ehmen, Spacelink manager at MSFC.

Ehmen explained that in 1991 Internet access capability was added, meaning free access for many customers and a big boost in the number of Spacelink users. Due to the dramatic boost in usage, the service "really took off." But there was something even bigger on the horizon - the World Wide Web.

"The world Wide Web was coming. Teachers would soon be using it and we knew it,"said Ehmen. "We have always been a little ahead of the curve and have managed to stay there, evolving as technology evolves."

Today, Spacelink is a nationally recognized Web site that features links to a library of educational and news services, current events, and teaching side. Its search engine also serves as a guide to help people locate any publicly accessible NASA information on the Web. Although this service is primarily intended for educators and students, it is also a user friendly quide for anyone who wishes to navigate NASA's many web sites.

"With the voloume of information posted by all NASA centers every day, it can be hard to find a specific bit of information," said Ehmen. "With Spacelink we take an agency-wide look at what NASA does and make it easy for the educator to quickly find NASA-related information. An educator doesn't have to understand NASA's organizational structure to know where to look. We think that's a strong feature."

As the world speeds ahead through the "Information Age," Spacelink continues to lead the way in online informational resources. According to Ehmen, Spacelink has a very loyal audience of educators, students, and the general public. "We're here because we provide a useful resource for the educational community and because we continue to evolve as technology evolves," said Ehmen.

Learn more about Spacelink at <http://spacelink.nasa.gov/.index.html>. ∎

NASA, CISCO Systems Collaborate on Next Generation Internet

NASA and Cisco Systems, Inc. of San Jose, California, are collaborating to test and demonstrate Next Generation Internet (NGI) hardware and software following the recent signing of a Memorandum of Understanding. According to Kenneth Ford, Ames Research Center's (ARC) Associate Director for Information Technology, ARC plans to work with Cisco in projects that may lead to significant technical, scientific, and economic benefits for the parties involved in the agreement, as well as for the nation. By 2002, research and development by NASA and five other federal agencies on the NGI initiative could result in information flowing over the Internet 100 to 1,000 times faster than today's speeds, according to NASA engineers.

"We are proud of our origins and long association with the world's finest educational institutions. Universities are engines of high-tech research. The Next-Generation Initiative is a wise and far-sighted investment that will enable our campuses and national research labs to continue to be world-leading drivers of technology and innovation," said John Morgridge, chairman of Cisco's Board of Directors and former CEO, expressing early support for NGI.

"Cisco has been working closely with government research scientists on an informal basis for many years," added James Massa, Director, Cisco Systems Federal Operations. "This memo of understanding reinforces this commitment, and elevates the arrangement to a more formal effort."

ARC is leading NASA's portion of a federal project to develop the NGI. In addition to NASA, the principal federal agencies involved in NGI include the National Science Foundation, the Defense Advanced Research Projects Agency, the Department of Energy and the National Institutes of Health.

"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," said Christine Falsetti, NGI Project Manager at ARC.

According to Falsetti, NASA and other Federal agencies will conduct research and development that could interconnect "core sites" with high speed lines. She explained that technical advances will spin-off from NGI, and industry will put improvements into the 'old' Internet to make it work better and faster.

"Our work should eventually allow users to do things that they can't do today via the Internet," she said. "For example, consumers might be able to see high quality video programs "on demand" and use high quality teleconferencing via the Internet as a result of this work."

AWARDS

Visualization Videotape Wins International Award

The "Images of Earth and Space: SC97 Edition" videotape won an award of "Excellence" in the Society for Technical Communication's 1997-98 International Technical Video Competition. The video features visualizations from Goddard Space Flight Center, the Jet Propulsion Laboratory, and NASA HPCC Earth and Space Sciences Project Grand Challenge investigation teams. It premiered at NASA's research exhibit at the annual SuperComputing conference, SC97, last November. A display of all winning videotapes will take place at the Society's annual conference, May 17-20, in Anaheim, California.

NASA monetary awards

Members of the Science Data Processing Systems Section recently received monetary awards from NASA for creative development of technically significant software: Dave Freda Galileo S-Band Software Zareh Gorjian Surveyor Ray Bambery Virtual Reality Multimission Atlas User Interface (VR-MAUI)

Additionally, Mike Martin received a NASA cash award for supporting the development of NASAVIEW, a simple cross platform viewer for Planetary data sets which the Data Distribution Laboratory has helped to develop. ∎

The goal of NASA's many outreach programs is to promote to the general public an understanding of how NASA makes significant contributions to American education systems and to institutions dedicated to improving science literacy. This newsletter provides one vehicle for reporting how applications and hardware used for space science and other NASA research and development can be adapted for use by teachers and their students and by non-NASA organizations.

"Women of the World" Project Features Exceptional Female Role Models

Quest's Women of NASA (WON) project is sponsoring a new educational initiative called "Women of the World." Through this program, WON hosts quarterly online chats with the nation's most successful females in a wide range of professions, offering young people anywhere opportunities and experiences to gain insight into their own future choices. This project provides students, parents, and schools a unique learning opportunity to dialogue with our nation's female leaders - women typically not accessible to the public - via the World Wide Web.

Many fields of expertise are represented in the online chats; women in medicine, politics, sports, business, the entertainment industry, space exploration, law, journalism, broadcasting, high technology, and one woman who lays claim to being a homemaker, the wife of the Vice President of the United States, Tipper Gore.

"I believe women have been and continue to be our country's traditional caregivers and, as such, need to struggle with basic questions of family and community," said MS. Gore. "We juggle our careers with the many concerns of family life, while also trying to remember that we are part of a larger community."

"In my life, I take pride in my role as a homemaker who also had the opportunity to pursue personal interests such as photography and working on mental health and homelessness issues. This is an exciting time when a woman can achieve anything she sets out to do. Set your goals high and remain true to your vision and your heart."

WOW sponsored the third anual "Virtual Take Our Daughters to Work Day" this April, featuring ten select female leaders from a broad spectrum of professions who met online with hundreds of students, parents, and schools worldwide to discuss and celebrate opportunities, as well as gain insight into the professional and personal aspects of their lives.

During each hour of the day from 6:00 a.m. - 4:00 p.m. Pacific Time one select women was available for conversation via a live web chat. These women were selected based on their diverse professions, background, and experiences; their education and training; their interesting career paths, and the positive impact their dialogue would have on young people. You may read the profiles of the women featured in the WOW project and the schedule of chats by accessing Quest's WOW website <http://quest.arc.nasa.gov/women/TODTWD97/wow.html >.

Learn more about Quest projects at <http://quest.arc.nasa.gov/>. ∎

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Elizabeth City State University Reaches Minority Schools With Information Technology

The Minority University-Space Interdisciplinary Network (MU-SPIN), an educational outreach program funded by MURED and managed by Goddard Space Flight Center, was started in 1990 to transfer the wide area networking technology to the minority colleges/universities and encourage the use of this technology for interdisciplinary research. During the early phase of the program, the emphasis was on network connectivity and training for the minority institutions. As a result of the MU-SPIN program, approximately 50 minority colleges/universities and Kindergarten Through Grade12 (K-12) schools are connected to the Internet and about 10,000 people have been trained.

To reach an even larger number of colleges/universities and also include K-12 schools, NASA's Office of Equal Opportunity Programs' Minority University Research and Education Division (MURED) funded seven universities in 1995 to serve as Network Resource and Training Sites (NRTS). Each NRTS is the lead institution in a consortium of other colleges/universities and K-12 schools in its region. It provides network connectivity, training, and computers to its collaborative partners.

The Elizabeth City State University (ECSU) NRTS, which services the Northeastern Region of North Carolina and Eastern Virginia Region, has collaborative partners that include sixteen K-12 schools (six elementary, five middle and five high schools). It has made an impact in that region with its information systems training workshops and K-12 outreach activities. ECSU introduced thirteen high potential students from the I.C. Norcom High School's PRIDE Program to the Internet and desktop publishing as part of the Learning Internet Networking Knowledge, called LINK, Project at Emily Spong Elementary School (an ECSU collaborative partner). The students became familiar with the Internet history, applications, and guided practices, as well as the use of scanners and digital cameras for desktop publishing. ECSU has also reached the K-12 educators in North Carolina with its Hertfor County, Camden County, Pasquotank County, and Halifax County Training Events (WWW Browsing and Searching, Basics of HTML Homepage Design, Electronic Mail, Hot Sites for Educator I, Integration of the Internet into the Classroom, and WWW

Search Engines). Hundreds of educators in both North Carolina and Virginia participated in the Fall 1997 World Wide Web Educators Conference and the extended training events during summer 1997.
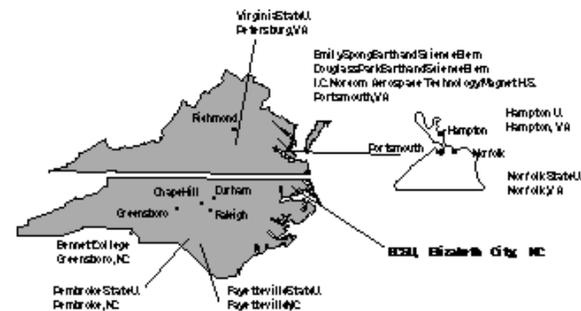
Seven funded NRTS universities

In addition to these activities with its collaborative partners, ECSU expended a considerable amount of effort with its community center technology outreach program which has grown out of a Memorandum Of Agreement (MOA) with Langley Research Center (LaRC). Through that effort, three satellite training centers in Virginia have been established: at Emily Spong Elementary (15 computers), The Whitaker Center (12 computers) and Lincoln Park Center (five computers). HUD has given ECSU about $39,000 for Herrington Village in North Carolina through their Neighborhood Networks program and ECSU is putting 12 computers into Elizabeth City Middle School to establish another satellite training center. All of the centers other than Herrington Village have been equipped with used computers from LaRC through the Stevenson Wylder Act program. Satellite sites are staffed with people trained through the ECSU NRTS.

As part of its ongoing training activities, the ECSU NRTS provides workshops on the following topics: Designing and Implementing Local Area Networks (LANs), LAN/WAN Planning Issues, Data Communication Hardware, NASA's Atlas Model for Low Cost Connectivity, LAN Software & Management, and Installing and Configuring Internet Software. In 1997-1998, a total of 46 training workshops were conducted, with 809 attendees.

Learn more about this program at http://muspin.gsfc.nasa.gov/>.■

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NASA Hosts the Fifth Annual Great Moon Buggy Race

Marshall Space Flight Center (MSFC) once again sponsored the Great Moon Buggy Race, the fifth in an annual series. This race is a challenging hands-on experience for students that combines creative engineering, teamwork, and the spirit of competition. The creative inventions were modeled after the NASA Lunar Roving Vehicle that was used by astronauts to travel the Moon's surface.

Teams representing 11 colleges and high schools from across the US competed in the event, racing their versions of a "moon buggy" over a half-mile course of simulated lunar terrain. Regardless of how well a team performed, all the participants learn about resolving engineering problems and about the engineering challenges of the space program.

The team of students representing the College of New Jersey rolled to victory and won a trip to Kennedy Space Center to view a Space Shuttle launch. In the high school division, a team from Monterey High School, in Monterey, Lousiana, finished in first place, winning a weekend at US Space Camp in Huntsville.

College teams competing in the race were the College of New Jersey-Ewing, New Jersey, the University of Evansville-Indiana, Pittsburg State University-Kansas, Southern Illinois University-Illinois, Arizona State University, Auburn University-Alaska, the University of Puerto Rico, and the University of Tennessee. High school teams participating were Eastlake High School from Chula Vista, California, Autauga County Vocational Center, Prattville, Alabama, and Monterey High School, Monterey, Lousiana.

Top prizes included trips for winning team members to Kennedy Space Center to view a shuttle launch and trips to US Space Camp. Along with MSFC, other sponsors were the American Institute of Aeronautics and Astronautics; the Alabama Aerospace Teachers Association, sponsor of the Space Camp prize; and the US Space & Rocket Center.

Excerpted from NASA press release 98-050, written by Jerry Berg, MSFC. Photo credit: MSFC homepage. ■

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.

NASA Signs Information Technology Cooperative Agreement

NASA officials recently signed a cooperative agreement with The Aerospace Corporation in El Segundo, California, to stimulate advances in information technology for incorporation into NASA programs. This is the 124th such agreement signed since January,1996, by officials from Ames Research Center (ARC). NASA has signed the network of agreements with 94 companies, 23 universities, and seven other federal agencies to support agency goals, to leverage information technology resources, and to promote use of NASA technologies.

"We will perform joint research with The Aerospace Corporation to develop information technology in support of space missions and other NASA research," said Dr. Kenneth Ford, ARC's associate director for Information Technology, who signed the agreement on behalf of NASA. "Making spacecraft more self-sufficient, or 'autonomous,' by equipping them with intelligent computers is an example of how Aerospace and NASA could work together."

"Automated decision-support systems can assist in monitoring data from spacecraft, detecting and diagnosing problems, and suggesting solutions to decrease the workload for ground-control operations," said Dr. Sergio Alvarado of the Computer Systems Division at Aerospace.

Dr Alvarado explained that satellites with intelligent systems onboard will be able to periodically correct their attitude and orientation, manage their orbits and perform exploratory missions in deep space on their own initiative. The partnership with NASA will allow Aerospace Corporation to share information technology that we are now applying to Air Force space programs.

Developing and using autonomous spacecraft, machines and systems that are smart, adaptable, curious, and self-sufficient is one of five critical technology areas that NASA has identified to accomplish its strategic goals. The other four technologies include:

- integrated design systems that will enable global work teams to form in order to reduce the design cycle time for development of aircraft and spacecraft
- space systems operations to reduce spacecraft launch and operations costs
- large-scale information and simulation technology to use advanced computers and networks to manage the vast amount of data gathered by satellites supporting NASA's Earth Science Program
- aviation operations to improve air travel safety while increasing capacity of airports to handle increases in the number of flights during the next decade

To date, ARC has achieved a number of successes in pursuit of agency objectives in these areas. Examples of such accomplishments include:

- on-going work on 3-D computerized reconstructive facial and breast surgery and robotic brain surgery technology being developed by NASA and Stanford University
- continuing development by government, industry and academia of the Next Generation Internet that will run as much as 1,000 faster than today's Internet. The new Internet will enable long distance medical diagnosis and worldwide scientific collaboration that require quick transmission of huge data files
- use of NASA's high-speed Darwin computer network by Boeing, other aerospace companies and NASA. The partners work together through the powerful, Internet-like system to instantly analyze tests of airplane models inside wind tunnel test sections. Air blows around airplane and rocket shapes in the tunnels to simulate flight. Engineers expect Darwin to reduce the design cycle time for airplanes by about a quarter
- a virtual laboratory that permits people located thousands of miles away to participate in experimental, simulated flights of airplanes and spacecraft using the world's biggest vertical motion simulator at Ames. Engineers take part in experiments from a distance after computer systems are shipped to locations remote from ARC

Excerpted from NASA press release, #PR 98-20, written by John Bluck, ARC, and David L. Jonta, The Aerospace Corporation.

To learn more about these information technologies, also, see:

Next Generation Internet Showcased at Technology 2007
<http://www-sisn.jpl.nasa.gov/ISSUE44/NGI_techTrans.html>

Cutting Design Time With VLAB
<http://www-sisn.jpl.nasa.gov/ISSUE46/vlab.html>

NASA Aids FIght Against Cancer
<http://www-sisn.jpl.nasa.gov/ISSUE45/Cancer.html>

Robot "Brain Surgeon" Visits New York Convention
<http://www-sisn.jpl.nasa.gov/ISSUE43/43robot_brain.html>. ∎

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.

NASA Program Spawns Safety Software for Pilots

Two new software packages enabling pilots to use laptops to avoid hazardous terrain and find their place on maps are the latest success stories of NASA technology transfer, bringing together entrepreneurs and space engineers. "TerrAvoid" and "Position Integrity," which combine Global Positioning Satellite (GPS) data with high-resolution maps of the Earth's topography, were initially designed for military sponsors and are now poised for availability in the consumer market within the next few months. Pilots of small planes, for whom such tools have been, until now, largely unavailable&emdashdue to cost and the sheer size of bulky hardware&emdashmay soon be able to carry onboard the personal computer equivalent of collision-avoidance systems currently used by the military and commercial airlines.

Arranging affiliations

Jet Propulsion Laboratory's (JPL) Technology Applications Program (TAP) gives American industry assistance from NASA experts and facilitates business use of intellectual property developed for the space program. TAP strives to do this in several ways: by supporting the NASA/JPL mission, by encouraging dual-use technologies (technologies that have application both in the space program and in the private sector), by helping US companies compete in the global economy, and by supporting projects that are in the public interest. NASA has similar technology transfer programs at its other centers

Four years ago TAP arranged a partnership between JPL's Cartographic Applications Group and Nevin Bryant and the start-up company of Dubbs & Severino, Inc., based in Irvine,

California. Dubbs & Severino had an idea for mapping software to help private airplane pilots, inspired in part by the fatal crash of a pilot friend of company president Bob Severino. The twist: the package was to be completely software-driven, instead of requiring expensive hardware, as was the norm up to that time. Bryant had developed GeoTIFF, an architecture standard providing geo-location tools for mapping applications. GeoTIFF proved to be the crucial key that the start-up company needed to bring the idea to fruition, allowing the firm to develop low-cost software packages.

GeoTIFF is now in the public domain, and its use for commercial product development has evolved into an industry standard over the last year. Through TAP, Dubbs & Severino obtained JPL's assistance early on and thus gained a jump-start in adapting the architecture for their products' specific needs.

About the software

"TerrAvoid" is a terrain avoidance system that graphically shows pilots if they are flying dangerously close to mountains; safe sections can be seen in green, while hazardous sections show up in red, with those proportions changing in real-time as the pilot moves through hilly terrain. In a sense, the system "looks" out over a plane's pilot for upcoming hazards. Integrating GPS tracking data with maps on CD-ROM, this software package is approximately 1/20th the cost of its nearest competitor.
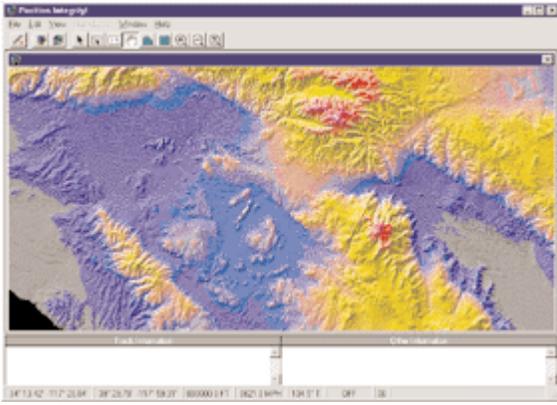
Credit: TAP Success Stories "Terrain Mapping for Pilots" image.

"Position Integrity," which also co-registers realtime GPS data with local maps on CD-ROM, is a moving map detailing the exact position of the pilot. Because of the unique features of GeoTIFF, this software can be adapted to operate with any map, chart or photo image in the world, while comparable versions are limited solely to either military, scientific, or commercial maps. GeoTIFF also enables the package to feature four windows at once, a useful and unique option for pilots who need to work simultaneously with maps, charts, photo images, and sketches at different scales and zoom levels. According to Severino, GeoTIFF enables terrain avoidance and navigation map packages to manipulate the pixels in each image intelligently, making costly hardware unnecessary. Its indexing scheme organizes large numbers of pixels efficiently and inexpensively, compressing and capturing huge amounts of data into a seamless image file. It has paved the way for sophisticated mapping software to be made available not just to major commercial airlines but also to small-plane pilots around the world. ■