SCIENCE INFORMATION SYSTEMS NEWSLETTER

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http://www-sisn.jpl.nasa.gov

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The purpose of the Science Information Systems Newsletter *is to inform the space science and applications research community about information systems development and to promote coordination and collabo-ration by providing a forum for communication. This publication focuses on programs sponsored by the Research Management Information Systems in support of NASA's Office of Space Science. Articles of interest for other programs and agencies are presented as well.*

Features

Departments

Calendar

June

12-13 The International Climate Change Conference and technologies Exhibition, Baltimore, MD; 301-695-3762; FAX: 301-295-0175.

July

7-10 Third International Airborne Remote Sensing conference, Copenhagen, Denmark; ERIM/ Airborne Conference; 313-994-1200,x 3234; FAX: 313-994-5123.

7-10 IGARSS '97, Cannes, France; 703-917-865f5; khazenie@chrpisis.gsfc.nasa.gov

7-11 Seventeenth Annual ESRI User Conference, San Diego, CA; ESRI; uc97@esri.com; http://www.esri.com

Feature

NASA Observes Hale-Bopp

As the orbit of Comet Hale-Bopp approached the Sun in late March, NASA and agency-supported scientists studied the large and bright comet using sounding rockets, spacecraft and ground-based observations. Using the Hubble Space Telescope, Hale-Bopp's nucleus was measured at roughly three to four times larger than that of comet Halley (six miles in diameter), making it one of the largest comets ever observed. Researchers studied Hale-Bopp to better understand comets, primitive bodies of loosely-packed ice and dust that many scientists consider the best-preserved remnants of the early solar system.

The Wallops Flight Facility (WFF), Wallops Island, Virginia, conducted four sounding rocket launches, beginning March 24 through April 5. The missions, launched by the US Navy at the White Sands Missile Range (WSMR) in New Mexico, carried payloads that observed the comet in the ultraviolet wavelengths of light for about five minutes before returning to Earth.

The joint NASA/European Space Agency Ulysses spacecraft, now in solar orbit, is studying what happens to comets as they are exposed to different solar wind conditions at various solar latitudes. Because Hale-Bopp was to enter the Sun's lower latitude zone, where solar wind (a continuous outflow of charged particles streaming from the Sun in all directions at a million miles per hour) is disturbed compared with the equatorial regions, dramatic changes in the comet's plasma tail were expected to occur at these lower celestial latitudes.

Ulysses Comet Watch, a collaboration between the Jet Propulsion Laboratory (JPL) in California and the University of Colorado, provided images from more than 200 amateur observers around the world. These images are posted World Wide Web homepage at:

http://lasp.colorado.edu/ucw/hb/hb_images.html

The Hubble Space Telescope, which has been observing the comet, particularly the nucleus, since September 1995, will not observe Hale-Bopp during the next few months because the comet is too close to the Sun; Hubble's sensitive detectors could be damaged if pointed in that direction.

The Polar spacecraft observed Hale-Bopp using ultraviolet and visible imaging instruments. Images obtained by Polar are also posted to the Web at:

http://pao.gsfc.nasa.gov/gsfc/spacesci/pictures/spacepic.html.

Scientists have been using the Infrared Telescope Facility on Mauna Kea in Hawaii to observe Hale-Bopp in the infrared region of the spectrum. Their observations will be made through Hale-Bopp's perihelion and continue until summer. NASA will also fly the Southwest Ultraviolet Imaging System experiment on the Space Shuttle Discovery's STS-85 mission in July. The experiment is designed to observe the comet more extensively during the 11-day mission. Additionally, NASA and the National Science Foundation are collaborating on ground-based observations and analyses of Hale-Bopp.

JPL hosted a public event called "Comet Chasers: On the Trail of a Comet" on Friday, April 11. Activities included a comet viewing session and a round-table discussion of the study of comets and NASA's role in comet studies, featuring David Levy, co-discoverer of Comet Shoemaker-Levy 9, Don Yeomans of JPL, and Alan Hale and Thomas Bopp, co-discoverers of Comet Hale-Bopp.

Astronomers from around the world have submitted more than 4,500 images of Comet Hale-Bopp to NASA Web sites, where you can see them and enjoy the celestial show. Access the Comet Hale-Bopp homepage at JPL or the Near-Live Comet Watching System at NASA Headquarters at, respectively:

http:/ /www.jpl.nasa.gov/comet/index.html

Excerpted from a NASA press release, written by Diane Ainsworth/Jane Platt JPL, and from NASA press release 197-4, written by Brian Dunbar, NASA Headquarters. Please note that photos are copyrighted.

Prepared for the Office of Space Science Information Systems through an agreement with the Jet Propulsion Laboratory. Questions on the newsletter effort may be sent to Sue LaVoie at: 818-354-5677; sue_lavoie@iplmail.jpl.nasa.gov

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Contributing Editors are Pat Kaspar, Ames Research Center, and Judy Laue, Goddard Space Flight Center.

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Lead Feature

Huntress Explains Newest Vision of NASA Space Science

Diane E. Miller, Science Writer, Jet Propulsion Laboratory

Wes Huntress, NASA Associate Director for Space science, was hosted by the Caltech Management Association for an April 17 talk in Jet Propulsion Laaboratory's (JPL) Von Kaarman Auditorium on "The Future Direction of NASA's Space Science Program." To a standing-room-only audience, he began by reviewing the cold war from the early 50's through the breakup of the Soviett Union in 1991 as the driving force behind the space program. According to Huntress, the space program almost broke the US economy and contributed to the breaking of the Soviet ecomomy.

NASA's products are intangible, but extremely valuable: discovery, the knowledge that comes from it, adventure, and the vision of a better future."—Dr. Wesley Huntress, NASA

Renewed interest, new drivers

Since '91 NASA has had to work hard to justify the continued exploration of space. With the recent discovery of possible evidence of one-time primitive life forms on Mars, Congress and the American people have shown new interest in space exploration, particularly with respect to the origins of life and the probablitty of it's existence elsewhere in the universe, even in our own solar system. Say Huntrress, "NASA must recognize and respond to the needs and dessires of its' stakeholders—the public, scientists, and Congress. NASA's products are intangible, but extremely valuable: discovery, the knowledge that comes from it, adventure, and the vision of a better future."

Because the cold war no longer drives NASA's budget allocations, space science missions are being done differencly. Instead of being mission driven, at almost any cost, they are now cost driven. NASA will do no more large missions, such as Galileo and Cassini. In the future there will be international cooper-ation to share costs and missions will incorporate new technologies, with managed risk.

"W need to invest to build technology-rich spacecraft, and JPL is the place to do it," Huntress emphasized, referring especially to NASA's New Millennium Program.

New directions

Huntress described NASA's five space science programs: the Mars Exploration Program, the Origins Program, the New Millennium Program, the Discovery Program, and the Outer Planets Program.

The Mars Program (currently flying Mars Global Surveyor and Mars Pathfinder) will gather information from planetary orbiters, flybys, and sample returns that may lead to a more definitive answer to whether there at one time was life on that planet. The Origins Program includes observations from new-generation Earth-and-space-based telescopes and interferometers to detect and image possible Earth-like planets around other stars. The New Millennium Program focuses on research, development, and validation of new, cost-effective spaccraft technologies, such as those that would allow the sspacecraft to operate for long periods with no Earth-based monitoring or intervention. The Discovery missions are low-cost, innovative, solar-system science missions that use advanced, yet proven, technologies, partnering NASA with industry, and providing strong opportunities to promote education and public awareness.

Aftter discussing the space science programs, Huntress explained JPL's role in the NASA organization. JPL is NASA's only Federally-funded research and development center (FFDRC). As an FFDRC, JPL must, according to government policies and restrictions, be given only work for which it has unique capabilities or interest, work that cannot be done by private industry.

In conclusion, Huntress showed the audience what is generally felt to be the most enduring image of the Apollo program, a full-sphere shot of planet Earth floating in space. He then displayed an artist's rendering of what he hopes is the enduring product of the next 20 years of NASA space science, an equally detailed image of an Earth-like planet (which happens to have a ring) floating in space near a different star.

Supercomputer Simulates Hyakutake

Lynn Chandler, Goddard Space Flight Center, and Sally Pobojewski, University of Michigan

A supercomputer simulation of Comet Hyakutake's interaction with the solar wind demonstrates that resulting X-ray emissions can be used to monitor comets and solar wind phenomena, NASA-funded researchers write in the current issue of *Science*. The simulation was conducted using an Earth sciences supercomputer at the Goddard Space Flight Center (GSFC). The results match and explain March 27, 1996, observations of Comet Hyakutake by Germany's ROSAT satellite, the first detection of X-ray emissions from any comet. The model also supports a leading theory for how the X-rays are generated.

The theory

"Cometary X-rays present a potentially powerful new tool to monitor comet activity far from Earth, as well as the composition and flux of the solar wind," said the *Science* article co-author Tamas Gombosi of the University of Michigan. "By capturing these X-rays' detailed energy spectrum, it might be possible to monitor the propagation and evolution of spectacular solar wind phenomena, such as the coronal mass ejections seen this January and April."

About one percent of the solar wind, which flows from the Sun out past Pluto, is composed of minor ions; atoms (such as oxygen, carbon and neon) that have been nearly stripped of their electrons and thus have a high positive charge. Thomas Cravens of the University of Kansas theorizes that these minor ions steal electrons from neutral atoms and molecules of cometary origin. The electrons are first seized in excited states, traveling in the ions' outer orbitals. As the electrons fall to lower orbitals, Cravens' theory asserts that X-rays are emitted, in addition to other forms of radiation.

"Considering the magnitude and shape of the emission, we believe the most satisfactory theory to be this mechanism of charge exchange excitation," Gombosi said. "Other explanations produce neither the crescent pattern nor the intensity observed by ROSAT and duplicated by our simulation."

Within this pattern, some electron orbital transitions emit distinct wavelengths of X-rays that can be measured. The computer simulation shows that the overall X-ray spectrum for Comet Hyakutake depends mainly on the solar wind composition, and not on the comet. Because of this independence, researchers can determine the relative size of the comet's atmosphere from the proximity of the brightest X-rays to the icy nucleus.

"In Hyakutake, the brightest X-ray region was 18,700 miles (30,000 kilometers) ahead of the comet, on the Sun side," said University of Michigan co-author Michael Combi. "If the comet has enough of an atmosphere, the solar wind minor ions recombine with electrons far from the nucleus. If the comet were producing less atmospheric gas, the place of maximum emission would be closer to the nucleus," Combi said.

Testing the theory

This theory will also be tested on Comet Hale-Bopp, which is scheduled to be observed by Japan's ASCA X-ray satellite this September. "Comet Hale-Bopp should have the emission shifted further sunward; it is bigger than Hyakutake," Combi said.

Active comets are typically first observed in visible light at large distances from the Sun. After discovery, the orbits of comets can be established with very high accuracy as they pass through the inner solar system. "If X-rays are observed from the known location of a

comet, one can conclude with great confidence that the X-rays originated from the comet," Gombosi said.

The University of Michigan team used March 27, 1996, solar wind density measurements from NASA's **WIND** spacecraft. Their model first considers the global interaction of the solar wind with the comet. It projects the comet into a three-dimensional grid that automatically applies finer resolution where more activity occurs. This physics component predicts the deflective paths and speed of the solar wind traveling through the comet.

Simulation images are available on the World Wide Web at:

http://hpcc.engin.umich.edu/HPCC/recent3/index.html

Acknowledgments

Other co-authors of the Science paper are Roman Haberli, Darren De Zeeuw, and Kenneth Powell. The University of Michigan team is one of nine Grand Challenge Investigations funded by NASA's High Performance Computing and Communication Program's Earth and Space Sciences Project. Additional funding comes from NASA's Office of Space Science, the National Science Foundation, and the Swiss National Science Foundation.

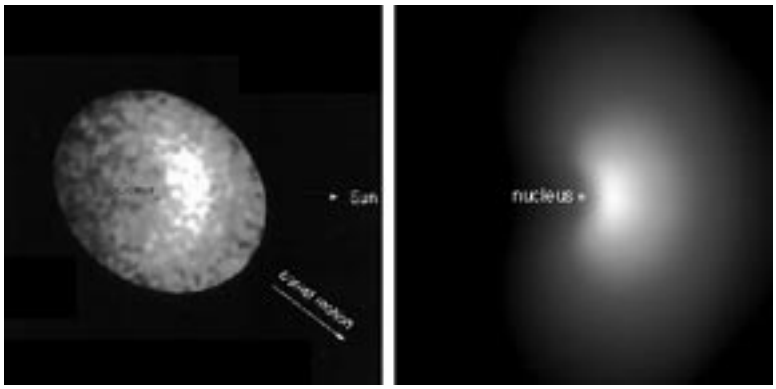


Image (A) of the X-ray emission from Hyakutake, measured by the ROSAT HRI on 27 March 1996. Computed image (B) of sum of all emission lines in the HRI passband caused by the charge exchange of solar wind ions with cometary gas. In both images, the X-ray emission shows a crescent shape and the maximum of the emission is displaced Sunward from the nucleus.The scale of both images is the same.

Feature

Teaching Remote Sensing on the Web

Jon Robinson, Hughes STX, and Judy Laue, Hughes STX, Goddard Space Flight Center

The Remote Sensing Tutorial is an over-100-page, World Wide Web (WWW), college-level tutorial produced by Nick Short, Sr. (retired) and Jon Robinson of Hughes STX. The tutorial is sponsored by the Applied Information Science Branch of Goddard Space Flight Center's Earth and Space Data Computing Division. The tutorial explains how remote sensing is applied in studying the environments of Earth as well as the role of space technology in monitoring Earth's surface and atmosphere. The tutorial describes past uses of aerial photography and space imagery as records of Earth's geography as well as future plans for more-advanced monitoring systems. Through the tutorial, you develop skills in interpreting and analyzing satellite images and aerial photographs by direct inspection and computer processing.

Using the WWW

The project began as *The Landsat Tutorial Workbook: Basics of Satellite Remote Sensing*, written by Nick Short, Sr. in 1982 (NASA Ref. Publication 1078). Short and Robinson have been collaborating for almost two years to post the contents of the workbook to the WWW in a manner that takes advantage of the WWW's interactivity. Posting the workbook to the Internet is cost-effective for NASA, because the site contains many color-intensive graphics that would be expensive to reproduce in print. The authors consider the WWW tutorial to be

a living, organic document that will grow and change as remote sensing technology evolves, and as ways of presenting information on the WWW improve.

The Remote Sensing Tutorial instructs through a series of short sections, each focused on one or more relevant topics. These sections are accompanied by discussions and progress into hands-on interactive instruction. Each section concentrates on a local or regional area or on a topical theme. Several "standard" space images are usually the focal points of a section, with computer-based processing renditions, ground photos, and descriptive maps providing added details where appropriate.

About the tutorial

The tutorial begins by introducing the principles of physics (especially electromagnetic radiation) underlying remote sensing, then considers the main kinds of observing platforms in use, and closes with a recounting of the history of satellite systems with an accent on LANDSAT.

The first section introduces most of the major concepts behind image analysis and interpretation by "walking" you through product types and processing output in common use. The next eight sections treat specific applications and introduce SPOT, the French satellite system. Section Nine examines in depth what scientists have learned about these fascinating worlds—planets, satellites, and asteroids. A survey of basic ideas underlying astronomy and cosmology is also in this section.

A comprehensive summary (soon to be online) of the main achievements in the exploration of the Solar System is offered in Section 19, "Planetary Remote Sensing."

The tutorial includes links to relevant sources of information on remote sensing, including federal and international programs as well as educational and commercial organizations that provide training and services.

To present elaborate instruction suitable for the topic of remote sensing, the site includes large and color-intensive graphics that are designed for loading with higher-end bandwidth Internet connections. Although the pictures are an integral part of the tutorial, users with lower-end bandwidth can choose not to load the pictures, and they will still benefit from the instructional text. Users from other countries have requested mirror sites to speed download.

Browser statistics

According to browser statistics, this heavily accessed site has had traffic from over 50 countries, including Croatia, Colombia, Indonesia, Malta, France, Russian Federation, Israel, S. Africa, and S. Korea, as well as from numerous nonprofit institutions. Fifteen percent of the bytes used were from educational institutions.

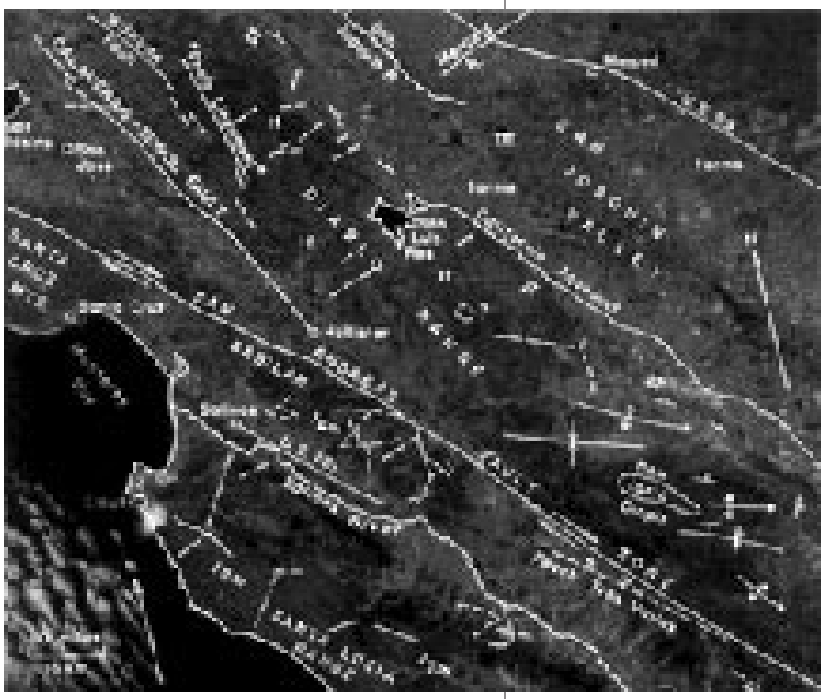
For further information on the Remote Sensing Tutorial contact:

Jon Robinson at 301-286-0681

To view the tutorial on the WWW access:

http://code935.gsfc.nasa.gov/IIFS-html/LT/NewTutorial/intro1.html

"The Remote Sensing Tutorial helps make NASA data understandable and accessible to the public, whose tax dollars have paid for NASA's remote sensing research since the early 1970's,"
— Jon Robinson, Hughes STX



Paul D.Lowman, Jr, a geologist at Goddard Space Flight Center and expert on space photography, drew this geologic- structures map on the inaugural color composite image of the central California coast around Monterey Bay, acquired 3 days after the launch of ERTS-1 (Landsat-1).

Feature

Using Artificial Intelligence Planning to Automate Image Processing

Forest Fisher and Steve Chien, Jet Propulsion Laboratory, and Edisanter Lo and Ronald Greeley, Department of Geology, Arizona State University

Recent breakthroughs in imaging technology have led to an explosion of available data in image format. However, these advances in imaging technology have brought with them a commensurate increase in the complexity of image processing and analysis technology.

Processing complexities

When analyzing newly available image data to discover patterns or to confirm scientific theories, a complex set of operations is often required. First, before the data can be used it must often be reformatted, cleaned, and have many correction steps applied. Then, in order to perform the actual data analysis, you must manage all of the analysis software packages and their requirements on format, required information, etc. Furthermore, this data analysis process is not a one-shot process. Typically a scientist will set up some sort of analysis and study the results. Then the results will be used to modify the analysis, to improve it. This analysis and refinement cycle may occur many times. Thus any reduction in the effort or cycle time can dramatically improve scientists' productivity.

Consider the goal of studying the soil sediment transport (wind erosion patterns). In order to do this the scientist uses a z0map (described later) to analyze the surface wind velocities using synthetic aperture radar (SAR) data. In order to generate the z0map, the scientist must go through a number of processes:

- data acquisition—getting the data from a proprietary tape format using the Committee on Earth Observing Sensors reader software package
- data conversion—the data must be decompressed using yet another software package
- preprocessing—header and label files must be added to the data files
- processing—using the z0map software package, a z0map image is created
- post processing—depending on the desired data format, the z0map image files may need to be converted to Video Image Communication and Retrieval (VICAR) format (yet another proprietary format)

Unfortunately, this data preparation and analysis process is both knowledge and labor intensive. Correctly producing this science product for analysis requires knowledge of 1) the particular science discipline of interest (e.g., atmospheric science, planetary geology), 2) image processing, and 3) the image processing libraries available. Also required are an understanding of where and how the images and associated information are stored (e.g., calibration files) and the overall image processing environment, to know how to link together libraries and pass information from one program to another.

It may take many years of training and expertise to acquire the breadth of knowledge necessary in all areas to perform these analyses. Such experts are in high demand. Additionally, considerable knowledge of software infrastructure is desirable, such as knowing how to specify input parameters (format, type, and options) for each software package being used and how to translate information from one package to another, which may take considerable effort. Using automated planning technology to represent and automate many of these data analysis functions [1:p.50], [2] enables novice users to utilize software libraries to prepare and analyze data. Such technology also allows the user who may be expert in some areas but less knowledgable in others to use the software tools.

Planning-technology elements

To address the knowledge-based software reconfiguration problem in general, and

science data analysis in specific, techniques from artificial intelligence planning were applied and extended.[1] Planning technology relies on an encoding of possible actions in the domain. In this encoding,you specify for each action in the domain: preconditions, post-conditions, and sub-activities.

Preconditions are requirements that must be met before the action can be taken. These may be pieces of information that are required to correctly apply a software package, such as the image format, availability of calibration data, etc. Postconditions are things that are made true by the execution of the actions, such as the fact that the data has been photometrically corrected (corrected for the relative location of the lighting source) or that 3D topography information has been extracted from an image. Sub-activities are lower level activities that comprise the higher level activity.

For an example of sub-activities, let us return to our previous example of analyzing soil sediment transport using SAR data, the different tasks (e.g., data acquisition, data conversion, etc.) are considered subtasks of the overall product generation process. The planner begins with the process of "determining parameters." This in turn is driven by the type of data format or mode of the SAR during data collection. Through this decomposition process parameters to be used in the z0map calculation are initialized. Given this encoding of actions, a planner is able to solve individual problems, where each problem is a current state and a set of goals. The planner uses its action models to synthesize a plan (a set of actions) to achieve the goals from the current state.

Planning consists of three main mechanisms: subgoaling, task decomposition, and conflict analysis. In subgoaling, a planner ensures that all of the preconditions of actions in the plan are met. This can be done by ensuring that they are true in the initial state or by adding appropriate actions to the plan. In task decomposition, the planner ensures that all high level (abstract) activities are expanded so that the lower level activities (sub-activities) are present in the plan. This ensures that the plan consists of executable activities. Conflict analysis ensures that different portions of the plan do not interfere with each other.

An automated processing system

The Automated SAR Image Processing (ASIP) system[2] is an end-to-end image processing system that automates data abstraction, decompression, and (radar) image processing subsystems, and intelligently integrates a number of SAR and z0 image processing subsystems. ASIP automates synthetic aperture radar (SAR) image processing based on user request and a knowledge-base model of SAR image processing using artificial intelligence (AI) automated planning techniques. SAR operates simultaneously in multipolarizations and multifrequencies to produce different images consisting of radar backscatter coefficients (s0) through different polarizations at different frequencies.

Using a knowledge base of SAR processing actions and a general purpose planning engine, ASIP reasons about the parameter and subsystem constraints and requirements. In this fashion ASIP extracts needed parameters from image format and header files as appropriate, relieving the need to know these aspects of the problem. These parameters, in conjunction with the knowledge-base of SAR processing steps and a minimal set of required user inputs (entered through a single graphical user interface), are then used to determine the processing plan.

ASIP represents a number of processing constraints. For example, ASIP represents the fact that only some subset of all possible combinations of polarizations are legal (as dependent on the input data). ASIP also represents image processing knowledge about how to use polarization and frequency band information to compute parameters used for

Constructing maps

ASIP enables construction of aerodynamic roughness image/maps (z0 map) from raw data, enabling studies of Aeolian processes. The aerodynamic roughness length (z0) is the height above a surface at which a wind profile assumes zero velocity. z0 is an important parameter in studies of atmospheric circulation

1.For more details on planning technology see [3], [4].

2. For more detail on the ASIP sytem see [5].

and aeolian sediment transport (in layman's terms: wind patterns, wind erosion patterns, and sand/soil drift caused by wind) [6], [7], [8]. Estimating z0 with radar is beneficial because large areas can be mapped quickly to study aeolian processes, as opposed to the slow and painstaking process of manually taking field measurements [9]. The final science product is a VICAR image called a z0 map that scientists use to study the aeolian processes. The z0map figure shows an aerodynamic roughness length map of a site near Death Valley, California, generated using the ASIP system (the map uses the L band (24 cm) SAR with HV polarization). Each of the color bands indicated signifies a different approximate aerodynamic roughness length. This map is then used to study aeolian processes at the Death Valley site.

Conclusions

Since the ASIP system has been fielded, it has proven to be useful for generating aerodynamic roughness maps, with three major benefits. First, ASIP has enabled a 10 fold reduction in the number of manual inputs required to produce an aerodynamic roughness map. Second, ASIP has enabled a 30% reduction in CPU processing time to produce such a map. Third, and most significantly, ASIP has enabled scientists to process their own data (previously programming staff were required). By enabling scientists to directly manipulate the data, and reducing processing overhead and turnaround, science is directly enhanced.

For further information on ASIP contact Steve Chien at:

steve.chien@jpl.nasa.gov

To view an Aerodynamic roughness length map produced using the Automated SAR Image Processing System access:

http://www-aig.jpl.nasa.gov/planning/asip

Acknowledgments

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Planetary Data System—

Available CD-ROMs

The following data are available on CD-ROM and can be ordered by accessing the Planetary Data System (PDS) Catalog or by contacting the PDS Operator for assistance. Data are available to Office of Space Science scientists free of charge and to all others from the National Space Science Data Center for a nominal fee. The Catalog is available via the World Wide Web at:

http://pds.jpl.nasa.gov/

Select PDS Data Set Catalog listed under PDS Hot Topics!

- Clementine to the Moon Experiment Data Records - 88 volumes
- Earth Geologic Remote Sensing Field Experiment - 9 volumes
- Galileo to Jupiter Near Infrared Mapping Spectrometer EDR - 4 volumes
- Galileo to Jupiter Solid State Imaging REDR From Earth 2 Encounter - 15 volumes
- International Halley Watch Comet Halley Chronological Data - 25 volumes
- International Halley Watch Comets Crommelin and Giacobini-Zinner Data—1 volume
- Pre-Magellan Radar and Gravity Data - 1 volume
- Magellan to Venus Full Resolution Mosaic Image Data - 77 volumes
- Magellan to Venus Compressed-Once Mosaic Image Data - 45 volumes
- Magellan to Venus Compressed-Twice Mosaic Image Data - 20 volumes
- Magellan to Venus Compressed-Thrice Mosaic Image Data - 6 volumes
- Magellan to Venus Altimetry and Radiometry Composite Data - 19 volumes
- Magellan to Venus Global Altimetry and Radiometry Data - 2 volumes
- Magellan to Venus Line Of Sight Acceleration Profile Data Record - 1 volume
- Magellan to Venus Full-Resolution Radar Mosaics - 149 volumes
- Pioneer Venus Orbiter Magnetometer, Electric Field Detector, Ephemeris Data - 67 volumes
- Pioneer Venus Orbiter Supplementary Experiment Data Records - 4 volumes
- Pioneer Venus Orbiter Neutral Mass Spectrometer Data - 1 volume
- Viking Orbiter I to Mars Experimental Data Record Images - 32 volumes
- Viking Orbiter II to Mars Experimental Data Record Images - 14 volumes
- Viking Orbiter to Mars Digital Image Map - 14 volumes
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- Voyager Images of Saturn - 5 volumes
- Voyager Images of Uranus - 3 volumes
- Voyager Fields and Particles Data of Neptune—1 volume
- Voyager Fields and Particles Data of Uranus— 1 volume
- Welcome to the Planets Educational Resource - 1 volume

For further information contact the PDS Operator at:
pds_operator@jplpds.jpl.nasa.gov
818-306-6130

Visions of the Next 50 Years in Computing

The Association of Computing Machinery (ACM) hosted its annual convention, themed "The Next 50 Years of Computing", in San Jose, California, on March 1-5. Global leaders in industry, research, academia, and government were on hand to engage in discussions on the future direction and effects of computing_ the impact of information technology on education, medicine, communications, entertainment, quality of life, and social and economic freedom.

The ACM, reputedly the largest international professional computing society, provides a global forum for the exchange of knowledge about computing and information technology. The Association's goal is to advance the skills of information technology professionals and students throughout the world. Members of the ACM come from .

Conference activities

ACM97 kicked off on Saturday by opening the extensive exposition. Activities for ACM97's second day included a discussion of "Copyright and the Net: Is Legislation the Answer?", the annual awards dinner, and the 21st Intercollegiate Programming Contest, sponsored by Microsoft in collaboration with the ACM.

Students from fifty colleges and universities worldwide participated in the intercollegiate programming competition, which is a test of programming talent and race against time to solve real life programming challenges. To qualify for the contest finals, teams competed in regional contests from late October through early December. At the conference finals, the top teams from each region competed in a five hour battle to solve as many real life programming problems as possible. The teams that solved the most problems in the fewest attempts earned scholarships and software awards, as well as the appropriate titles: Overall champion, North American champion, European champion, or Asia/Pacific champion.

ACM97 was officially opened on Monday morning, with welcoming speeches by ACM President, Chuck House, and ACM97 Chair, Bob Metcalfe. James Burke, a science journalist on the Discovery channel and a columnist for *Scientific American*, was this year's conference emcee. The conference featured a series of plenary sessions from invited speakers—key technologists—who shared their views on the next 50 years of technology. Session presenters included William Perry, US Secretary of Defense, and noted journalists, educators, and researchers, such as Gordon Bell of Microsoft Corporation, Vint Cerf of MCI Communications corporation, Carver Mead of the California Institute of Technology, and Bran Ferren of the Walt Disney Company. James Burke presented the closing comments on Wednesday. To read abstracts of each session's topic access:

http://www.vxtreme.com/live/acm97/live.html

On Tuesday the teenage essay contest winners were announced. Dubbed the "joystick generation", high school students, grades 9-12 or equivalent, were given the opportunity to win college scholarships and trips to the conference by forecasting the future of the culture they are helping to create. The students were asked to imagine how computing technologies will change their lives over the next 50 years, then submit an essay to the "ACM97 Vision of the Future" contest. The essays were judged by committee on the basis of creativity.

"Our criterion for judging is not whether a student's essay ideas can actually be implemented. We are more interested in getting kids to realize that whatever choices they make with computer science, the choices will have future implications for society, economy, and across all spectrums of life," said Fred Abatemarco, editor in chief of *Popular Science* magazine. The magazine and ACM sponsored the contest.

"Today's high school students are the first people to grow up in a computer-focused

society. Their energy and vision is a crucial part of ACM97 since they are the ones who will help make critical decisions about technology and who will be most affected by information technology in the next millennium," said Bob Metcalfe, ACM97 chairman.

Exhibits and demonstrations

The exposition focused on technologies of the future plus a whimsical view of "back to the future". Visitors experienced technology in the year 2047 as well as the "paleotechnic" look back at technology, as it was at the end of the 20th century. A variety of exhibits were showcased, including a pavilion of well-known companies in the computer and software industry; the SIGGRAPH computer animation theater and computer generated art; the digital circus, a hands-on exhibit for children; the computer museum special photography collection; and several noncommercial exhibits from universities and government entities.

Ames Research Center provided visitors a look at the virtual windtunnel, an application of virtual reality interface technology to the visualization of the results of modern computational fluid dynamics simulations. The demonstrated 3D sketching for scene generation, scientific visualization, and imaging. "SKETCH" uses simple non-photorealistic rendering and a gestural interface based on simplified line drawings of primitives that allows all operations to be specified within the 3D world.

At the Digital Circus, kids could construct a city on the World Wide Web (WWW). East Carolina University demonstrated practical, real time telemedicine. I-Force from Immersion Corporation let visitor touch and feel computer simulations by using a "force-feedback joystick". An IBM researcher and the Sacramento King's coaching assistant jointly demonstrated "Advanced Scout", a performance-analysis data-mining package utilized by teams in the national Basketball Association (NBA). This technology uses algorithms to sort and analyze data, allowing NBA coaches to create game strategies with patterns in game data and video.

Silicon Graphics Inc. showcased applications of leading-edge computer graphics technology and its influence on everyday life and the future. The demonstrations included: a virtual reality theater; the debut of a virtual reality modelling language cartoon series that will soon air on the WWW; and the Shoah Visual History foundation Project, a database that holds thousand of interactive, personal testimonies from Holocaust survivors.

To learn about all of the exhibits in the expo access:

http://www.acm.org/acm97/expo/exhibitors.html

The forum

During the conference attendees had the opportunity to participate in an electronic survey, called the "forum", sharing their thoughts on the future of technology. You will soon be able to read what ACM97 attendees had to say on the following topics:

- How ubiquitous will computers become over the next 50 years?
- What can be done to make computers usable by a far greater number of people?
- What's going to happen with nano-technology and computers as sensory extensions?
- Utopian Visions: Your Vision of the Next Fifty Years of Technology Access for All?
- Creating an equal access on-line future 2084 or not?
- Security and privacy in future computing environments.
- Keeping things decent and open: Challenges of online discourse

To participate in "A National Survey of Public Attitudes Toward Computers" access <http://www.acm.org/acm97/forums/forums.html>. Add your thoughts on the future of technology to ACM's growing database and perhaps fashion the theme of next year's conference.

HUBBLE'S Upgrades Yield Sharp Views of Mars/Other New Data

Ray Villard, Space Telescope Science Institute, and Tammy Jones, Goddard Space Flight Center

Three months after an orbital house call by astronauts, new instruments aboard the Hubble Space Telescope are helping astronomers probe the universe in greater detail than ever before. "We're extremely excited about the quality and precision of the images from Hubble," said Wes Huntress, associate administrator for Space Science. "Following check-out of the instruments, Hubble will return to full science operations, and we can expect a continuing flow of new and exciting discoveries."

Hubble status

Project officials are encouraged that a problem detected earlier with one of the cameras on the infrared instrument has shown some improvement. The problem stems from the unexpected movement of the dewar—an insulated vessel containing solid nitrogen at extremely cold temperatures. After launch, the nitrogen expanded more than expected as it warmed, moving the dewar into contact with another surface in the mechanism and pushing one of the cameras out of its range of focus. The camera has moved back about one-third of the distance required to be within reach of the instrument's internal focusing mechanism. This is because the dewar is "relaxing" toward its normal state, as pressure caused by the expansion of the nitrogen is reduced. The ice keeps the sensitive infrared detector cooled. Project officials also are considering how to deal with unexpected, excessive coolant loss.

"We are anticipating a shorter lifetime for the instrument, but we don't know how much shorter," said Goddard Space Flight Center's (GSFC) Hubble Project Scientist, David Leckrone. "We are taking steps to work around the problem, and will increase the percentage of time this instrument will be used."

NASA officials also report that other upgrades to Hubble are performing well, including the newly installed solid state recorder, fine guidance sensor, and solar array drive electronics. The solid state recorder has significantly improved data storage and playback, and the new fine guidance sensor is by far the best of the three on Hubble.

Best Mars views

Following the second servicing mission, the sharpest-ever views of the planet Mars taken Hubble's Wide Field Planetary Camera-2 (WFPC2) clearly show clouds, polar caps, and other bright and dark markings known to astronomers for more than a century. The images were taken just before Mars opposition—when the red planet comes closest to the Earth this year (about 60 million miles or 100 million km). Each picture element (pixel) in WFPC2's Planetary Camera's image spans 13 miles (22 km) on the Martian surface.

These images show the planet during the transition between spring and summer in the northern hemisphere (summer solstice). The annual north-polar, carbon-dioxide frost (dry ice) cap is rapidly subliming, revealing the much smaller permanent water-ice cap, along with a few nearby detached regions of surface frost.

Hubble is being used to monitor dust storm activity to support the Mars Pathfinder and Mars Global Surveyor Orbiter Missions, which are currently en route to Mars. Hubble's "weather report" from these images, is invaluable for Mars Pathfinder, which is scheduled for a July 4 landing. These images show no evidence for large-scale dust storm activity, which plagued a previous Mars mission in the early 1970s.

Recent observations

The initial results following the servicing demonstrate the ability of the new instruments to fulfill astronomers' science goals with the telescope. Among Hubble's recent observations are:

- *Jets and Gaseous DiskAround the Egg Nebula*—a new infrared instrument peered deep into the dust-obscured central region around a dying star embedded in the Egg nebula, a cloud of dust and gas 3,000 light years from Earth. The new images provide a clear view of a twin pair of narrow bullet-shaped "jets" of gas and dust blasted into space. The instrument, called the Near Infrared Camera and Multi-Object Spectrometer, also revealed an unusual scalloped edge along a doughnut-shaped molecular hydrogen cloud in the nebula.

Because we can now see these 'missing pieces' in infrared and visible light, we have a more complete view of the dynamic and complicated structure of the star," said Rodger Thompson of the University of Arizona-Tucson, the principal investigator for the infrared instrument. "It also allows us to see a 'fossil record' of the star's late evolutionary stages."

- *Unveiling Violent Star Birth in the Orion Nebula*—the new infrared instrument penetrated the shroud of dust along the back wall of the Orion nebula, located in the "sword" of the constellation Orion. Data revealed what can happen to a stellar neighborhood when massive young stars begin to violently eject material into the surrounding molecular cloud. Although ground-based infrared cameras have previously observed this hidden region known as OMC-1, the Hubble's new instrument provides the most detailed look yet at the heart of this giant molecular cloud. Hubble reveals a surprising array of complex structures, including clumps, bubbles, and knots of material. Most remarkable are "bullets" composed of molecular hydrogen, the fastest of which travels at more than one million mph (500 km/s). These bullets are colliding with slower-moving material, creating bow shocks, like a speedboat racing across water.
- *Monster Black Hole in Galaxy M84*—in a single exposure, a new powerful instrument called the Space Telescope Imaging Spectrograph discovered a black hole at least 300 million times the mass of the Sun. The spectrograph made a precise observation along a narrow slit across the center of galaxy M84, located 50 million light-years away. This allowed the instrument to measure the increasing velocity of a disk of gas orbiting the black hole. To scientists, this represents the signature of a black hole, among the most direct evidence obtained to date. Due to their nature, it's impossible to directly photograph black holes. Scientists must instead look for clues to show the effects of black holes on surrounding dust, gas and stars.

"Hubble proved the existence of supermassive black holes three years ago," said Bruce Woodgate, the principal investigator at GSFC for the new spectrograph. "With this new instrument, we can do it 40 times faster than we used to."

- *Composition and Structure of the Ring Around Supernova 1987A* —the new spectrograph also provides an unprecedented look at a unique and complex structure in the universe; a light-year-wide ring of glowing gas around Supernova 1987A, the closest supernova explosion in 400 years. The spectrograph dissects the ring's light to tell scientists which elements are in the ring and helps paint a picture of the physics and stellar processes which created the ring. This gives astronomers better insight into how stars evolve and become a supernova, and into the origin of the chemical elements created in these massive explosions.

For further information access the STSCI Web site at:

http://www.stsci.edu/pubinfo/PR/97/09.html

and via links in:

http://www.stsci.edu/pubinfo/latest.html

or

http://www.stsci.edu/pubinfo/pictures.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.

Spinoff

NASA Technology Helps Navy

NASA scientists have turned over to the US Navy the first phase of a data analysis program designed to find unexploded ordnance and mines in bays and harbors that were once used as gunnery ranges and test areas. Space program technology and computer applications are being adapted by Jet Propulsion Laboratory (JPL) to help identify underwater mines and ordnance in data from existing Navy sonar, laser, and magnetic instruments.

"The purpose of the program, called Mobile Underwater Debris Survey System, or MUDSS, is to demonstrate various technologies that can be used to survey former defense sites for unexploded waste," said Dr. Robert Somoano, MUDSS program manager at JPL. According to Somoana, some of the explosive debris in various bays and harbors has been in place since long before World War II.

Half way through the three-year effort, MUDSS is being conducted by JPL, under contract to the Department of Defense, with funding provided by the department's Strategic Environmental Research and Development Program. The work is being done in partnership with the Naval Coastal System Station, Naval Surface Warfare Center in Florida. Once the Navy finds the debris, the problem is turned over to the US Army, which has the responsibility for disposing of all unexploded military waste. The Army has its own program underway to clean up land bases.

JPL is also providing a chemical detector that will sniff out small traces of explosives in the water. The instruments are towed beneath the surface of the water on cables strung from a catamaran. To date, researchers have made about 150 runs over the targets with various combinations of sensors functioning.

Somoano explained that potential users of these systems include the Army Environmental Center, the Army Corps of Engineers, and the Navy Explosive Ordnance Disposal Technology Division. There also are potential commercial users, including underwater survey and cleanup, de-mining, archeology site survey, and law enforcement search operations.

Excerpted from NASA press release 96-131.

Spinoff

NASA Technologies Enter Space Hall of Fame

Three technologies originally developed by NASA to improve pilot and astronaut safety were inducted into the US Space Foundation's "Space Technology Hall of Fame" on April 11 of this year to honor their contribution to enhancing the quality of life on Earth. The technologies being recognized are those for anti-shock trousers, flame retardant seat materials, and the radiation barrier.

Ames Research Center's Director, Harry McDonald said of the honored technologies,. "They provide direct, quantifiable, and invaluable benefits to the American tax-payer and the domestic economy."

With these latest selections, 25 technologies have been inducted into the Hall since the awards began in 1988.

Excerpted from NASA press release 96-69, written by David Morse, ARC.

Spinoff

Automated Ground Terminal to Reduce Satellite Tracking Costs

Jim Doyle, Public Information Office, Jet Propulsion Laboratory

A new fully automated, miniaturized antenna station built from off-the-shelf electronic components will reduce the cost of tracking NASA's low-Earth-orbit satellites. The station, called a Low Earth Orbit (LEO) Terminal, was built at Jet Propulsion Laboratory (JPL) and tested to track and command the Cosmic Background Explorer (COBE) satellite without operator intervention.

"Analysis of the terminal logs and spacecraft telemetry indicated that the terminal worked flawlessly during the demonstration," said Nasser Golshan, task manager of the development effort.

Development

Development of the terminal was carried out in two phases by a small team of engineers at JPL and SeaSpace Inc., a satellite ground terminal manufacturer in San Diego, California. In the first phase, JPL upgraded a commercially available weather satellite-tracking terminal and developed a receive-only terminal to gather telemetry from NASA satellites.

That first phase was completed in 1994 with successful demonstrations tracking the Solar Anomalous and Magnetospheric Particle Explorer and the Extreme UltraViolet Explorer. In the second phase, command uplink capabilities were added and showed that the terminal's operation could be completely automated using COBE.

About the terminal

The terminal antenna is enclosed in a fiberglass dome called a radome. The radome protects the microwave electronics and the tracking mechanism from the elements. A four foot high cabinet houses the station electronics. For testing purposes, the terminal is located on the roof of an eight-story building at JPL.

Electronics include the telemetry receiver, a command exciter, the antenna controller and a computer workstation. When transmitting, the terminal uses a 200 watt solid state transmitter power amplifier.

The computer workstation allows for automated, unattended operations of the terminal including automated scheduling, calculation of orbital trajectories, control of the antenna positioner for spacecraft tracking, automated uplink and telemetry operations, communication interfaces for remote command operations, as well as processing and distribution of spacecraft engineering and science data to the mission operations and science users of the data.

The terminal can receive telemetry at rates up to 1.2 million bits per second. Uplink commands can be sent at up to 2,000 bits per second. Those rates and the operating frequency can be modified with replacement equipment.

Equipped with a 10 foot (3 meter) antenna dish, the terminal is capable of providing telemetry and command support to up to 55 percent of NASA's current and planned LEO missions. A 16 foot (5 meter) dish could extend coverage to 70 percent of the missions.

A benchmark

Commercial off-the-shelf software has been used extensively to reduce cost and increase reliability. Costs of the equipment and software are between $600,000 and $800,000 depending on the options.

"This demonstration sets a benchmark for low cost support of Earth-orbiting missions," said Chad Edwards, manager of the Deep Space Network Technology Program at JPL. "It also shows NASA can work closely with industry to take the best available commercial capabilities and quickly adapt them to meet the needs of NASA science missions."

OUTREACH

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.

NASA Honors its Space Science Student Competition Winners

Twenty-seven students from public and private schools across the US have won national recognition in NASA's 17th annual Space Science Student Involvement Program competition. The students were honored, along with their teachers, at the National Space Science Symposium, May 3-7, in Washington, DC. The competition, co-sponsored by NASA and the National Science Teachers Association, is an interdisciplinary program designed to address the need for greater literacy in the areas of science, critical and creative thinking, mathematics, and technology. Over 10,000 students in elementary, junior high, and high school competed in five competition categories using their skills in mathematics, science, technology, art and creative writing.

The symposium

The National Space Science Symposium brings together the 27 national winners and their teachers to recognize their academic achievement in an environment designed to further challenge their talents. The trip to the symposium includes formal presentations of their entries by the students.

In addition to their recognition in Washington, other awards include opportunities to intern at a NASA field center for a week during the summer, Space Camp scholarships, medals, ribbons, and certificates. Winners of the Interplanetary Art competition had their artwork displayed at the Marriott Metro Center Hotel during the symposium. Following the symposium, the artwork went on display in museums, schools, and other public sites and can be viewed by the public throughout this year.

The competitions

The symposium sponsors competitions in experiment/design and internships. The experiment competitions encompassed Mars science, interplanetary art, aircraft/spacecraft design, and Mission to Planet Earth. The internship competition offered aerospace, supercomputer, and space station interns.

- Mars Science Experiment - students in grades 9 -12 planned and developed a trip to Mars and proposed an experiment to be conducted along the way. Students were required to follow scientific research guidelines when designing the study.
- Interplanetary Art - students in grades 3 - 12 created two-dimensional illustrations of interplanetary space, accompanied by essays describing the pictures.
- Future Aircraft/Spacecraft Design - students in grades 3 - 5 worked in teams to design futuristic aircraft or spacecraft, with illustrations and essays describing the spacecraft.
- Mission To Planet Earth - students in grades 6 - 8, worked in teams to create interdisciplinary projects using satellites to study the effects of human activity on the Earth's ecosystem.

The students competed for internships with their teachers/advisors at NASA facilities and were chosen on the basis of a written proposals. The winners were granted aerospace, supercomputer, and space station Internships.

National Science Teachers Association—

NASA Adds "Lagniappe" to Educators' Annual Conference

In pursuing educational excellence, one of NASA's Strategic Outcomes from the Vision, Mission, and Goals section of the *NASA Strategic Plan* is to involve the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds. To this end, NASA participated in the National Science Teachers' Association (NSTA) annual national conference, held in New Orleans, Lousianna, this past April.

NASA provided lagniappe —"a little something extra for nothing"—to the overall theme of the conference, 'guaranteeing the opportunity to learn science.' Good times rolled in N'Awlins at the many, well-attended NASA workshops, seminars, and exhibition booths, where teachers from all grade levels were provided resource information and materials on space and Earth science.

Featured exhibits

The NASA-exhibits venue featured Earth, space, microgravity, and life sciences, and aeronautics. A hands-on demonstration area introduced World Wide Web (WWW) interactive resources, such as Quest, NASA's Classroom of the Future (COTF), and NASA's Educational Program with links to each field center, Jet Propulsion Laboratory (JPL), and various missions/projects. Attending teaachers were able to participate every half hour.

Quest is part of Learning Technologies and the Kindergarten Through Grade 12 (K-12) Internet Initiative <http://quest.arc.nasa.gov>. This " Internet in the Classroom" provides support and services for schools, teachers, and students on-line. Quest, managed by Ames Research Center, has won awards for its various interactive projects.

COTF <http://www.cotf.edu/> serves as NASA's principal research and development center for educational technologies, providing technology-based tools and resources to K-12 schools. COTF's philosophy is that development of products and services should be guided by the national standards of the National Council of Teachers and Mathematics and the National Academy of Science. The NSTA is currently promoting the use of nationwide standards for science curricula. Several teachers interviewed at the conference cited adoption of and adherence to such standards as a necessity in the development of resource materials and information.

At another popular booth, Spacelink, participants were taught how to connect to and navigate through NASA's electronic educational database. Spacelink, managed by Marshall Space Flight Center, is an on-line library of NASA educational resources found at <http://spacelink.msfc.nasa.gov>. Spacelink provides educational services, instructional materials, NASA news and fact sheets, information on NASA projects, hot topics, and cool picks. Hot topics include a movie and photo gallery from shuttle missions, anecdotes from shuttle team members, the latest info on current missions, such as Galileo discoveries and the progress of Mars Pathfinder, etc. Cool Picks provide links to other interesting Web sites.

The Education Program booth, sponsored by NASA's Education Division, provided literature on the many services NASA provides. Teachers received a variety of educational publications, including teachers' guides, posters, and lithographs.

The International Space Station exhibit featured live videoconferences with Johnson Space Center's Space Station Mock-Up and Training Facility, the Shuttle-Mir Docking Simulator, the Robotic Arm Simulator, and the Manned Maneuvering Unit fly-around (MMUF). The MMUF allowed participants to execute a fly-around of the International Space Station, viewed on a 36-inch monitor. This exhibit also offerred a CD-ROM with high-

NASA's Strategic Plan ***is to involve the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.***

fidelity, full-motion graphics, and an information database.

The Office of Space Science (OSS) <http://www.hq.nasa.gov/office/oss/> exhibit hosted scientists and flight program managers, to answer questions about the latest space science missions to Mars, Jupiter, Saturrn, the Sun, as well as Hubble Space Telescope discoveries. As part of the OSS exhibit, COTF demonstrated Astronomy Village, a multimedia program containing 10 complete investigations in astronomy. A variety of posters, activity packets, and planet lithographs were handed out.

Mission to Planet Earth (MTPE) <http://www.hq.nasa.gov/office/mtpe/> provided the latest news about a major initiative to understand our home planet. MTPE also gave out classroom materials, lithographs, and posters, and demonstrated Earth science imagery available on the WWW.

Other exhibtors included NASA ...On the Cutting Edge <http://www.okstate.edu/aesp/VC.html>, Lift Off to Learning, and the Shuttle Amateur Radio EXperiment (SAREX) <http://www.arrl.org/>. On the Cutting Edge provided literature on NASA's educational television programming available on the Web. Lift Off to Learning, available via Spacelink, provided its resource guide to video tape and other instructional materials. SAREX, a program that partners with NASA, uses amateur radio equipment on board the space shuttle and Mir Space Station to involve classrooms in the space program.

Seminars and workshops

The NASA Origins Program <http://origins.stsci.edu/> Director, Ed Weiler, was a featured speaker on the opening day of the conference. In his talk, *How Did We Get Here?,* Weiler said, "Astonomers approach this fundatmental question by looking far away, back toward the beginning of time to see galaxies forming, or by looking close to home, searching for planetary systems like our own around nearby stars. ...NASA's Origins Program will help answer [our] questions."

Throughout the five day conference NASA conducted seminars, discussions, and workshops, many with hands-on activities. Instructional short courses on Web navigation proved popular.

Telescopes in Education (TIE) <http://encke.jpl.nasa.gov/TIE/TIE_index.html>, a project developed and supported by JPL, presented a workshop on "Remote Astronomy from the Classroom." The TIE project in-volves students in hands-on astronomy and research utilizing a science-grade 24-inch reflecting telescope located at the Mount Wilson Observatory in Los Angeles, California.

MTPE held a teacher inservice for on-line Earth system science, utilizing COTF. This session introduced teachers to course content, technology, and methodology.

The Spaceborne Imaging Radar-C Educational CD-ROM was introduced in a workshop given jointly by JPL and a La Crescenta, California, high school teacher. This CD-ROM contains a teacher's guide, lesson plans, and science data collected from Earth orbit during two shuttle missions, was demonstrated.

One of the KidSat project's <http://www.jpl.nasa.gov/kidsat/> participating schools demonstrated how students communicate through the Internet with a shuttle digital camera to take pictures of the Earth. The students then retrieve the pictures and apply them to Earth science classes.

Johnson Space Center demonstrated the challenges and difficulties of robot space exploration. This focused particularly on on planetary exploration.

Other agencies partially funded by or partnered with NASA participated in the conference: the National Science Foundation <http://www.nsf.gov/>, the US Geolocial Society <http://www.usgs.gov/>, the National Oceanic and Atmospheric Association <http://www.noaa.gov/>, the Global Learning tand Observations to Benefit the Earth Program <http://www.globe.gov/>, the US Space and Rocket Center <http://spacecamp.com/>, the Space Telescope Science Institute <http://www.stsci.edu/>, the Planetary Society, <http://planetary.org/> the Lunar and Planetary Institute <http://cass.jsc.nasa.gov/lpi.html>, the Army, and the Navy.

About NSTA

The NSTA <http://www.nsta.org/>, founded in 1944 and headquartered in Arlington, Virginia, is the largest org-anization in the world committed to promoting excellence and innovation in science teaching and learning for all. NSTA's current membership of more than 53,000 includes teachers and administrators, scientists, business and indus-try representatives, and others involved in science education.

Students Test Engineering Skills at the Fourth Annual "Great Moon Buggy Race"

Jerry Berg, Marshall Space Flight Center

The same spirit of ingenuity that produced NASA's lunar roving vehicle is back at work as college and high school students from around the country prepared for the fourth annual "Great Moon Buggy Race" in Huntsville, Alabama. Students put their engineering skills to the test by designing, building, and racing their versions of the "moon buggy" on a track simulating the lunar surface. Teams representing 16 colleges and high schools competed on, April 19 at the US Space and Rocket Center in Huntsville.

Competitors raced in the shadow of a giant Saturn V, like the rocket that boosted lunar rover to the moon, and a full-size space shuttle mock-up. The one-half mile race course is speckled with "lava ridges," "craters," and sandpits—simulating the lunar surface—as it winds through the Rocket Center's grounds. This year's moon buggy race was sponsored by Marshall Space Flight Center (MFSC), where the lunar roving vehicle and the Saturn V were designed and developed. The moon buggy helped astronauts explore their landing sites on the moon during the Apollo 15, 16, and 17 missions.

"The fascinating thing I see over and over is the students' interest in space," said Jim Dowdy, moon buggy competition coordinator at MSFC.""They go for anything that's connected to the space program. The competition enhances awareness of human exploration and development of space."

Each two-member team raced its human-powered buggy, piloted by one male and one female student. After a safety inspection of each vehicle, the competition began when the two crew members carried their moon buggy a distance of 20 feet and place it at the starting line. When signaled that the event clock was ticking, the crews unfolded and assembled their moon buggies from a bin no larger than a four-foot cube and raced around the course. The event clock stopped when the first vehicle and its crew crossed the finish line.

Prizes were awarded to the top three finishers. The top prize is a trip to Kennedy Space Center in Florida to watch a space shuttle launch. A prize also was awarded to the buggy judged to be the "best" design from an original, creative concept, offering the best technical solution to navigating on a planetary surface.

Teams included students from Arizona State University (Tempe), Auburn University (Auburn, Alabama), North Dakota State (Fargo), Ozark Community College (Springfield, Missouri), Pittsburg State University (Pittsburg, Kansas), Trenton State College (Trenton, New Jersey), University of Alabama in Huntsville, University of Evansville (Evansville, Indiana), University of Florida (Gainesville), University of Puerto Rico (Humacao), University of Vermont (Burlington), University of California (Santa Barbara), and the University of Tennessee (Knoxville). In addition to the college entries, there were three entries in the high school division: Bob Jones High School (Huntsville, Alabama), Monterey High School (Monterey, Lousianna), and Autauga County Vocational Center (Prattville, Alabama).

Other sponsors of the event included the American Institute of Aeronautics and Astronautics, Washington, DC, and the US Space and Rocket Center, Huntsville, Alabama.

Information Systems Program Activities

These reported current activities of NASA's Office of Space Science Information Systems Program reflect the combined efforts of many people.

Data Archiving and Management

Space Science Data Operation Office (SSDOO)
<http://www.gsfc.nasa.gov/c630/>

Space Physics Data Center (SPDC)

- The fields and information in the Space Physics Data Availability Catalog have been extended to accommodate additional NASA requirements. New options to generate printable summaries both for all investigations of a given mission and by investigation were added.

Astrophysics Data Center (ADC)

- To date the ADC has distributed over 15000 datasets on computer networks, tape, CD-ROM, microfiche, and microfilm to more than 3600 individual requesters.

National Space Science Data Center (NSSDC)

- Approximately 60 2GB platters of Dynamics Explore and International Sun-Earth Explorer data currently stored on Optimem 12S write-once-read-many optical disks is being copied to digital linear tape (DLT). A new Web-based interface is available for quick access to the spacecraft, experiment, and data set information contained in the NSSDC Master Catalog.

Planetary Data System (PDS)
<http://pds.jpl.nasa.gov/pds_home.html>

Imaging Node

- Actively working to complete the preparation for support during landed operations beginning July 4. Nearing completion on the definition of PDS labels and archive product formats for the IMP, APXS, ASI-MET, and Rover Cameras, and have delivered a World Wide Web (WWW)-based query tool to support access to acquired data. All developments will be used by project personnel during operations and then transitioned to post-mission use by the community at large.

Planetary Photojournal

- Have reached an agreement with Mars Pathfinder Project to post released images on the Photojournal in parallel with release to the media.

Information Systems Research and Technology

Applied Information Systems Research (AISR) Program
<http://www.hq.nasa.gov/office/oss/aisr/>

- Ongoing research programs. See the Grants Directory Index on the AISRP homepage for a listing of funded research awards.

Jet Propulsion Laboratory (JPL)/ Information System
<http://www-ias.jpl.nasa.gov/Amy/overview.html>

Mission Simulation and Planning

- The Simulator for Imager for Mars Pathfinder (SIMP) has been requested for the MARS'98 missions. The SIMP scene visualization capability is being extended as proposed support for the Stardust Discovery and Pluto Express missions.
- Completed the IMP Panorama Generator, an observation sequence modeling tool, and will continue to provide sequence gneration support for the IMP camera.
- Completed the Flight System Testbed (FST) Scene Generator, a visualization software to generate the images used to test flight software and hardware in the FST.

Science Visualization

- Created images for *Science* and *Nature* magazine covers.
- Integrating the Science Visualization Testbed into the end-to-end testbed in collaboration with the New Millennium Program, Space Interferometry Mission, FST, and Multimission Ground Support Office.

Science Data Analysis

- Expanding the Data Object to enable scaling, warping, and boolean operations.
- Performing renormalizing of data at the input to LinkWinds to support intercomparisons.
- Developing interfaces for data that is not regularly gridded.

Mission Data Archival and Dissemination

- The *Data Distribution Lab* is developing the Telecommunications Mission Operations Directorate Multimedia System.
- The *Navigation Ancillary Informaion Facility (NAIF)* has completed implementations of the Experimenter's Notebook component of the SPICE Events Kernel.
- *NAIF*'s Moving Object Support System was selected for use on SIRTF.
- The *Science Digital Data Preservation Task (SSDPT)* has preserved 25,951 tapes as of 2/97.
- The *SSDPT* processing was featured in a documentary film sponsored by the American Film Foundataion.
- The *SSDPT* assisted the Lunar and Planetary Institute with the preservation of Mariner 6/7 IRS data.

Parallel Visualization Technology

- Continuing the establishment of JMAX, a von Karman-based project on the Power Wall for new science presentation and public outreach.

Advanced Computing

Space Science Grand Challenges
<http://sdcd.gsfc.nasa.gov/ESS/grand-challenges.html>

- Ongoing research with Science Teams I and II.

High Performance Computing and Communications (HPCC)
<http://www.aero.hq.nasa.gov/hpcc/>

Earth and Space Data Computing Division (ESDCD) - Goddard Space Flight Center (GSFC)

- *The Science Computing Branch/NASA Center for Computational Sciences (NCCS)* UniTree traffic exceeded 1 terabyte (TB)/week. This milestone was achieved three times this year for the weeks of January 19, February 23, and March 2.
- The *NCCS* added Quad-SCSI disks to the UniTree system, increasing disk cache size from 155 gigabytes to 375 giga-bytes, allowing copies of files to stay on disk 2.4 times longer.
- *NCCS* replaced 20 Cray J90 CPUs with 32 J90se CPUs in the J90 system known as "charney", providing users with an up to 50 percent increase in speed of scalar codes.
- Two STK "Timberline" tape drives with integrated controllers were installed in the *NCCS* STK "Wolfcreek" silo, enhancing the performance of the SGI/Cray DMF mass storage subsystem by increasing the peak transfer rate from 36 MBs/sec to 48 MBs/sec.
- In *HPCC/Earth and Space Sciences (ESS)*, SGI/Cray installed a 256-processor Cray T3E with 32 GB of memory and 480 GB of disk in support of the ESS Grand Challenge applications. Based on the Netlib LinPak benchmark of 11/96 list of the world's most powerful computing systems, this system ranks fifth in the US and 11th in the world.
- *HPCC/ESS* installed a Storage Tek Powder-horn silo with four Redwood and eight Timberline drives and connected directly to the T3E to support data storage requirements of the ESS Grand Challenge teams.
- At *HPCC/ESS* all nine ESS Investigator teams achieved at least 10 gigaflops sustained performance on one or more key science codes using the T3D.
- The *Science Communication Technology Branch (SCTB)* was invited to host a NASA node in the Defense Advanced Research Projects Agency-initiated, n x 10 Gbps Multiwavelength Optical Network (MONET) testbed. MONET will be a high performance network segment of the Department of Defense's Next Generation Internet initiative that will be integrated into Advanced Technology Demonstration infrastructure.
- At *SCTB* Bill Fink achieved a new network throughput high water mark of 310 Mbps over the local high speed

asynchronous transfer mode network using the 622 Mbps network interface card in Sun UltraSPARC.

- At the *Applied Information Sciences Branch* four original beta-test prototype Regional Validation Centers (RVC) are operational, as RVC hardware and software were successfully installed and tested at the University of Hawaii and Clemson University. The other two RVCs are located at the University of Maryland-Baltimore and the University of Southwestern Louisiana.
- At the *Center of Excellence in Space Data and Information Sciences (CESDIS)* the HPCC Beowulf project has be delivering HPCC/ESS high speed network device driving software, over the past three years, for the Linux operating system to a large customer commmunity through commercial distribution by the RedHat Software publishing company. Now RedHat is test releasing the current version of the Beowulf cluster configuration and Linux tools that allow this community to easily construct Beowulf clusters.

HPCC/ESS -JPL

- See ongoing research at <http://olumpic.jpl.nasa.gov/>

National Coordination Offfice (NCO) for Computing, Information, and Communication

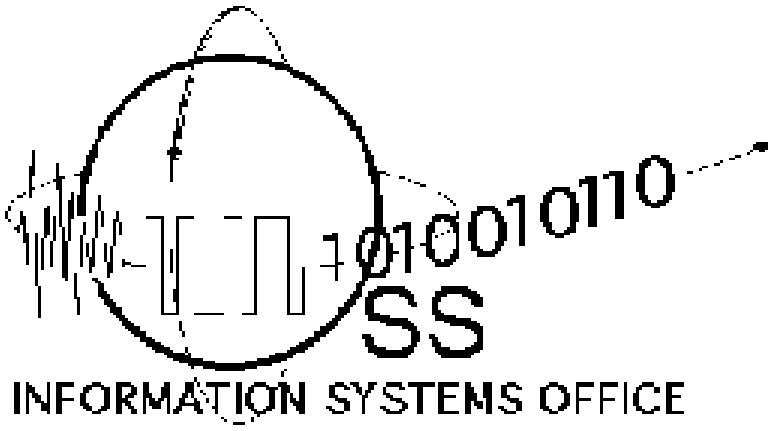
- See the "Whats New" NCO homepage <http://www.hpcc.gov/whats-new/index.html> for the newest links on the NCO Web Server.

Science Networking

NASA Internet (NI)
<http://nic.nasa.gov/ni/>

NASA Research and Education Network (NREN)

- Developed an interoperable architectural model with the Department of Energy and Lawrence Berkeley Laboratory for the establishment of research networking exchanges on the west and east coasts.
- Continued working with the NASA Integrated Services Network on a memorandum of understanding to provide bandwidth sharing across the Sprint ATM wide-area network service.
- Initiated development of 1996 performance measurements baseline from raw NI data.
- Began working on implementing three mission applications across NREN: Mars Pathfinder, NOMAD, and the Virtual Simulation Laboratory (VLAB). Johnson Space Center was established as an NREN demonstration node for the VLAB at DS-3 speed (45 Mbps) .
- Began work on implementing two NREN application from Lewis Research Center: echocardiography and collaborative simulation.
- Selected four NREN applications for submission as potential collaborative appplications for the NGI.



<http://www.hq.nasa.gov/office/oss/sthome.htm>