Jet Propulsion Laboratory

Universe

FEBRUARY
2007
VOLUME 37
NUMBER 2

Safe digs, far from home

JPL IS LEADING THE DEVELOPMENT OF INSTRUMENTS THAT WILL MONITOR SPACE HABITATS

By Mark Whalen

Amy Ryan shows the third-generation electronic nose, to be tested on the International Space Station.

Dutch Slager / JPL Photolab

Imagine in the near future a group of space travelers on their way to the moon, on the lunar surface, even to the planets or beyond. Any such trip is a long way from home and a long way back.

Whatever humans' ultimate destination in space may be, JPL is helping make the journey safer through its work with the Advanced Environmental Monitoring and Control Program.

Led by Darrell Jan, the organization develops technologies that detect environmental hazards and provide information to control systems that help maintain a safe environment for astronauts—in the space shuttle, the International Space Station, and potentially in lunar outposts. It's a great example of NASA collaboration, as well.

JPL is now developing the third generation of an electronic nose (E-nose), an array of chemical sensors designed to detect air contamination from spills and leaks. The device includes an array of 32 sensors that change electrical resistances when environmental composition changes. For the International Space Station, that could mean critical identification of threats to the astronauts' health, such as electrical fires or an overabundance of toxic chemicals.

The first-generation E-nose, successfully test flown on the space shuttle in 1998, acquired data on 10 analytes, or chemical compounds. This model was designed only to acquire the data, not to analyze it. Data were analyzed after the flight landed and the E-nose was returned to JPL. JPL also developed a second-generation model, which tested for the same 10 substances generation 1 did, plus 11 more. The generation 2 model underwent extensive environmental testing on the ground between 1999 and 2004.

Now, generation 3 is closer to making its debut in Earth orbit. E-nose principal investigator Amy Ryan and her team at JPL have developed a smaller, more powerful and more robust machine that will be delivered to NASA next year and bound for an upcoming shuttle flight to the International Space Station as a technology demonstration.

Generation 3 will detect, identify and quantify mercury and sulfur dioxide in addition to nine compounds that were also included in the tests of the first two generations. Further improvements from the second generation include upgraded electronics, power management, and hardware and software interfaces to an instrument rack on the space station that provides power and data transmission for the E-nose and other technology demonstrations. Generation 1's attendant computer and power converter will be replaced with an interface unit developed to interface between the JPL E-nose sensor unit and the instrument rack.

Part of the testing of the new unit, Ryan said, is its ability to transmit data as quickly as possible so that astronauts can one day heed those early warnings. To accomplish that, during its test run the data will be analyzed in near–real time on orbit and both the raw data and analysis results will be sent to JPL for further analysis. The final product, she said, will have a data display that will allow astronauts to gauge potential threats.

"The reason the E-nose that JPL built works so well is not only because it's got some good scientific fundamentals in its polymer selection, but also its very sophisticated software that can analyze the signals coming out of the polymer arrays, both quantitatively and qualitatively, and that's something that no other E-nose has," Jan said.

Also bound for the International Space Station in the near future is the Vehicle Cabin Atmosphere Monitor, a JPL-developed air-monitoring instrument. Attached to the same instrument rack that holds the E-nose, the Vehicle Cabin Atmosphere Monitor uses a gas chromatograph/mass spectrometer to detect trace amounts of organic molecules. At its heart is an ion trap mass spectrometer developed by Ara Chutjian of the Atomic and Molecular Physics Group coupled with a custom digital mass spectrometer control card developed by the Advanced Computer Systems and Technologies Group. The monitor's internal software performs the identification and quantification.

In the scientific community, the gas chromatograph is considered the gold-standard instrument for laboratory chemical analysis. The Vehicle Cabin Atmosphere Monitor provides this capability to the space station. The instrument will identify and quantify several dozen chemical compounds, based on three levels of priority, to the parts-per-million level. Until the technology's capabilities and accuracy are validated, noted instrument manager Arvid Croonquist, the Vehicle Cabin Atmosphere Monitor will operate without impacting crew members. During its on-orbit demonstration, a ground team will assess the data. When needed, crew members or ground controllers will be able to initiate a measurement.

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Dutch Slager / JPL Photolab

Rui Yang in the Microdevices Lab. His group developed a tiny laser for Mars Science Laboratory that will be adapted to different wavelengths for human space environments.

monitors

Continued from page 1

With the eventual goal to make both E-nose and the Vehicle Cabin Atmosphere Monitor as small as possible, the two instruments could potentially work in tandem.

"One day, you might have a small E-nose in each module of a spacecraft," Jan noted. "The Vehicle Cabin Atmosphere Monitor is more complex and therefore larger, although small for its capability, so you would have only one Vehicle Cabin Atmosphere Monitor unit at a central location. The smaller E-noses act like a first-alert stage. Then once something is detected by an E-nose, an astronaut could decide to take a sample with an airbag and then bring it to the Vehicle Cabin Atmosphere Monitor—which is a more sophisticated and sensitive device—and automatically perform a detailed chemical analysis."

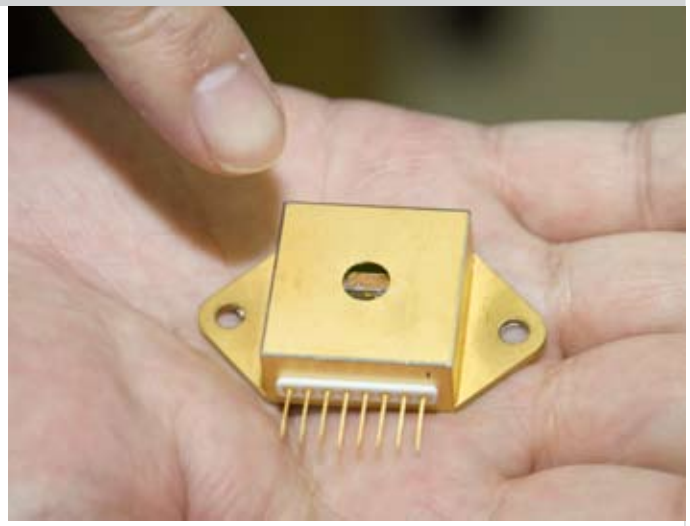
One of the challenges is to modify the instruments for use well beyond the space station. "Any incident that happens to the air on the Orion crew exploration vehicle, for example, will develop much more quickly because there's not much air in the vehicle to dilute it," Jan noted. "So the demands on the instrument on Orion will be much different than for the station."

The instruments are also under consideration for future lunar habitats and vehicles. "If you're in a lunar outpost long enough, you would need to recycle your air and water, so you'd need to assure that the processes recycling the air and water are functioning properly," Jan said. He noted that one design of a fairly sophisticated lunar rover—kind of like a big recreational vehicle—might house astronauts for weeks.

E-nose, which is scheduled to ship to Kennedy Space Center in November 2008, recently passed its critical design review; the same review for the Vehicle Cabin Atmosphere Monitor, scheduled to ship in February 2009, is now underway.

Besides those two, as part of the Advanced Environmental Monitoring and Control Program JPL is also managing the development of several other instruments with participation from industrial and NASA partners.

The Tunable Environmental Laser Spectrometer is based on a mid-infrared laser design by Rui Yang of the Infrared Photonics Group for the Tunable Laser Spectrometer on the Mars Science Laboratory mission. The gas-detection device also includes a quartz-enhanced photo acoustic spectroscopy detection system from Rice University; George Washington University will provide spectroscopy simulations as well as calibration and performance testing.



The miniature devices, as small as 10 microns by 1.5 millimeter, have been developed in JPL's Microdevices Laboratory

Yang said several of the lasers have been delivered to the Tunable Laser Spectrometer instrument team for tests. The miniature devices, as small as 10 microns by 1.5 millimeter, have been developed in JPL's Microdevices Laboratory. The tiny lasers generate infrared light; the current is used to fine-tune desired wavelengths to in turn measure the concentration and ratio of isotopes.

A particulate/dust monitor designed to help prevent fires in crewed environments is under development at Glenn Research Center. The device, using multiple sensor technologies to cover the entire respirable range, would combine light scattering and charge-based detection using microelectromechanical system technology.

A "lab on a chip" application development portable test system developed by Marshall Space Flight Center would demonstrate and validate rapid, real-time assessment of bacteria, yeast and mold on International Space Station surfaces.

The Colormetric Solid Phase Extraction water biocide monitor for the International Space Station, a partnership that includes Johnson Space Center and Arizona State University, targets the two chemicals, mercury and iodine, that are used to remove bacteria from the space station's drinking water. "These biocides are helpful in removing harming microorganisms," Jan said, "but they can be harmful to the crew if the concentration gets too high, as we know from ground tests."

A new level of SECURITY

Photo by Martin Perez

Lab will issue new NASA credential this year

Soon it will be time to prepare for another new identification credential, this one being the second in a two-step process to upgrade security at federal facilities nationwide.

The issuance of a new badge—a "smart card" containing a microprocessor chip with information to allow individuals physical and logical access—will begin in February and be completed by the end of October.

The effort stems from Homeland Security Presidential Directive 12, a 2004 requirement to verify identification of federal employees and their contractors and subcontractors. The first part of this standard establishes processes for verifying identification to gain physical access—you are who you say you are. The next step focuses on technical interoperability requirements, including the creation of the infrastructure to support the use of the credentials at all federal facilities, including JPL and all NASA centers.

Starting this month, all employees, affiliates and subcontract employees requiring unescorted access at the Laboratory will provide JPL Security with information such as name, social security number, date of birth and place of birth. Shortly thereafter, the employee will receive an invitation to visit a web site to complete a form that initiates a background investigation. To conclude the process, employees will supply two forms of identification, and obtain a new facial photo and a set of fingerprints, referred to as biometrics.

Given the current number of JPL badges issued, this will be a major undertaking. Jerry Suitor, manager of the Office of the Management System, noted about 5,600 JPL employees, along with about 5,000 affiliates and/or subcontractors, plus about 200 Caltech campus employees currently hold badges.

To provide an extra level of security, next year JPL will focus on the second part of the standard, using the badge to access JPL's network, applications, and individual computers. The idea is to have a plug-in badge reader available on all computers. The badge's embedded chip will include identification information unique to each user—a personal identification number, user name, photo, fingerprints and e-mail address—which may replace the need for passwords. "The hope for the future is once you log on, you're known by the system," said Suitor. "You now have credentialed identification that authenticates who you are."

For updated information, including a comprehensive list of frequently asked questions, please visit *http://hspd12.jpl.nasa.gov.* Questions and comments may be addressed to the JPL HSPD-12 message center at ext. 4-4050 or *hspd12@jpl.nasa.gov.*

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News Briefs

Jonas Zmuidzinas

Zmuidzinas to lead Microdevices Lab

Jonas Zmuidzinas has been named director of JPL's Microdevices Laboratory.

A Caltech professor of physics, Zmuidzinas also holds a joint appointment at JPL and is a longtime collaborator with Microdevices Laboratory researchers in areas that have focused, to date, on the science and development of detectors of long-wavelength radiation that permits researchers to pry into the deeper recesses and early state of the universe.

Zmuidzinas will report to JPL Chief Technologist Paul Dimotakis.

JPL space art exhibited

JPL visual strategist Dan Goods applies some of the complex principles studied at the Laboratory to his artwork in a project called "The Hidden Light," now underway through April 8 at the Pasadena Museum of California Art.

Goods' work makes scientific phenomena more accessible and meaningful. The Hidden Light begins with the idea that some physical entities in the universe are hidden or invisible until scientists discover new ways for understanding or seeing them.

The Hidden Light is presented in the museum's Project Room, a 700-square-foot gallery devoted to installations by early and mid-career California artists. Artists chosen to participate are charged with transforming the space through site-specific installations.

The museum is located at 490 E. Union St. Admission is free for museum members, $6 for adults, $4 for seniors and students. Call 626-568-3665 or visit *www.pmcaonline.org.*

Chinese New Year treats

JPL's Asian American Council is sponsoring a Chinese New Year luncheon on Thursday, March 1, from noon to 1:30 p.m. in von Kármán.

The price is $15 per person and payment is due Monday, Feb. 26. Menu items include golden shrimp rolls, shrimp with spiced salt, beef with broccoli, chicken with orange peel, sweet and sour spareribs, sole with crabmeat paste, assorted vegetables, fried rice, pan-fried noodles, shrimp shiu mai, crispy seafood balls, dessert, fruit and beverages.

For more information, contact *Winnie.P.Wang@jpl.nasa.gov* or ext. 3-5528.

New online purchasing system coming

iProcurement, an Oracle purchasing application, will replace Just-in-Time (JIT) beginning Feb. 26.

This new application provides a web-shopping interface allowing employees to quickly find goods and commodities from six online catalogs. Improved features include search engines using industry standards and integration with NBS applications and data.

With iProcurement going live, ordering capabilities on JIT will be turned off on Feb. 26. It is important that current certified users learn the new application and attain re-certification. Numerous hands-on training sessions have been scheduled beginning the week of Feb. 19. To register for a class, visit *http://hr/et* and search under the "New Business System" class catalog.

For everyone else, an online tutorial will provide an overview on how to place an order using iProcurement.

For training material and other information, visit *http://iprocurement.*

Passings

Frank Deligiannis, 45, supervisor of the Avionics Subsystem Engineering Group, died Jan. 21.

Delegiannis joined the Lab in 1985, beginning his JPL career developing battery technology for space applications. His early work on lithium-ion batteries led to the development of the batteries used in the Mars Exploration Rovers.

At JPL, he served as the lead battery engineer for the Mars Pathfinder Sojourner rover, was responsible for the development and delivery of a miniature microprocessor module for the Deep Space 2 Mars Microprobe mission, and was involved with the development of radiation-hardened electronics and materials for use at Jupiter. He eventually advanced to manage deep-space avionics development for the Prometheus Project. In addition to his duties as group supervisor, Delegiannis was leading the development of the computer element for the rover currently in development for the Mars Science Laboratory.

Delegiannis is survived by his wife, Susan.

A fund in Delegiannis' memory has been established at the Caltech Employees Federal Credit Union. Memorial services were held Feb. 10–11 at St. Anthony's Greek Orthodox Church in Pasadena.

William Breckenridge, 73, a Section 345 engineer, died Dec. 30.

Breckenridge had worked at JPL since 1956 and supported almost every flight project the Laboratory undertook.

Among his awards were a NASA Exceptional Engineering Achievement Medal and two NASA Exceptional Service Medals.

He is survived by his wife, Marian; children James, Carol Bee, John and Laurel Eby, eight grandchildren, two great grandchildren and sister Beverly Royer. Memorial services were held Jan. 6 at Mountain View Mortuary in Altadena.

Letters

Bill Breckenridge, who passed away Dec. 30, was a brilliant engineer who mentored and guided many others throughout his years at JPL. When some of his colleagues were asked to comment on his career, he was described as a giant and a true pioneer in the Guidance and Control discipline, a quiet man who was never arrogant or difficult and always willing to spend time to help others solve problems. He was one of the principal G&C architects for many of JPL's missions including Galileo and Cassini, as well as a key participant in many more projects over the years. His influence has had a profound and lasting impact on the American space program from its infancy through to the modern era. Engineers went to Bill not so much to discuss problems as to get answers. His legacy has been passed on to the scores of spacecraft engineers he mentored throughout his career.

Earl Maize

Your individual and group outpouring of love and support for our family at the death of my husband, Bill, was and is awesome! JPL's presence at his memorial will never be forgotten. Thank you all so much. After 49 years together, it's hard to even imagine a life without Bill. After 50 years of Viking, Voyager, Mariner, Galileo, Cassini, etc., I'm sure it's hard for you to imagine a life at JPL without him, but Mars awaits. And in 2009, when the Mars Science Laboratory is established there, I know Bill will call out from outer space: "I knew you could do that!" He believed in you—the team. I will never forget you. With heartfelt appreciation,

Marian Breckenridge

My personal thanks to Ken and Mary Halton for remembering me on my 85th birthday Jan. 28. I enjoyed the nice luncheon at the new Borders restaurant and visit afterwards with me at Glen Ivy. I hadn't seen them in 21 years since I retired from JPL in 1985. They enjoyed perusing through my 1997 seven-country cruise album, and remembering people we had worked with at JPL.

Ruth Morgan

My family and I would like to extend our heartfelt thanks to our friends at JPL for their support after the recent passing of my father-in-law, George Akahoshi. The potted plant and beautiful floral arrangements were fitting tributes to him. We were comforted by your expressions of sympathy and support.

Glenn Tsuyuki

Retirees

The following JPL employees retired in February:

David Miller, 42 years, Section 355; **Jerry Neal**, 41 years, Section 332D; **R. Frank Tillman**, 33 years, Section 352; **Lee Mellinger**, 30 years, Section 314; **Jose Zavala**, 29 years, Section 3765; **Fred O'Callaghan**, 28 years, Section 720; **Charles Keith**, 25 years, Section 345; **Choon-Foo Shih**, 24 years, Section 355; **Carol Dumain**, 23 years, Section 1082; **Tommy Worrel**, 22 years, Section 272; **Boris Lurie**, 21 years, Section 343H; **Carol Cundiff**, 19 years, Section 314D; **Larry McCain,** 11 years, Section 3756.

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Universe is published by the Office of Communications and Education of the Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109.