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tech transfer

GSFC NEWS

As Acting Head of the Microwave Instrument Technology Branch at Goddard, **Cathy Long** oversees radar technology development efforts, and serves as the main technical point of contact for GSFC's new agreement with Northrop Grumman. Read more about her work inside.

in this issue:

photo credit: Bill Hrybyk

NASA Goddard Technology Wins 2008 R&D 100 Award

NASA Goddard Space Flight Center racks up a triple play with the announcement that its Sensor Web 2.0 won an R&D 100 Award for 2008. This marks the third consecutive year that Goddard technology has been lauded at the ceremony that the *Chicago Tribune* dubbed the "Oscars of Invention." Each year, *R&D Magazine* selects 100 of the most innovative technologies that have the potential to further scientific discovery and greatly affect human life and the way we live.

Left to right: Pat Cappelaere, Stu Frye, and Dan Mandl lead the innovator team for the award-winning Sensor Web 2.0.

Goddard's Sensor Web 2.0 has already shown its capability in a recent wildfire management campaign in California. Particularly user friendly and cost effective, Sensor Web 2.0 requires little technical skill to use, thereby freeing up highly skilled programmers and engineers to attend to more technically demanding tasks.

A Web services–based software, Sensor Web 2.0 gathers and assimilates data from a network of sensors—seismic and GPS ground sensors, fire tower sensors, weather radar devices, and satellite sensors—enabling them to operate as a cohesive whole. By employing Workflow Management Coalition (WfMC) technology and taking advantage of emerging "mashup" capabilities, Sensor Web 2.0 enables users to set up sensor webs through point-and-click interfaces. Because the sensor integration path is not tied to a particular system, it strengthens the U.S. contribution to the Global Earth Observing System of Systems (GEOSS)—a collaborative effort of about 60 countries to form a network of Earth-observing systems. The result is a complete, real-time picture of Earth via shared global resources.

Dan Mandl, the innovation team leader, noted that while all sensor web initiatives work toward early detection of natural disasters, Sensor Web 2.0 has the advantages of being particularly user friendly and cost effective. "Scientists or emergency workers typically spend months or years working with a team of programmers to assemble sensors and data processing algorithms into workflows to accomplish an application," Mandl said. "Sensor Web 2.0 enables even students to assemble customized sensor web applications in a matter of hours or minutes, with no staff. Like the Internet, the usability will increase exponentially as the library of available workflows grows."

"If services such as Google Earth and Google Maps are any indication," said Nona Cheeks, Chief of Goddard's Innovative Partnerships Program Office, "the Sensor Web phenomenon may be on the verge of a megatrend."

Dan Mandl accepted the R&D 100 Award on Goddard's behalf at the Oct. 16 ceremony in Chicago. ■

IPP's Ted Mecum Receives FLC-MAR Partnership Award

The Federal Laboratory Consortium Mid-Atlantic Region has named Technology Transfer Manager Ted Mecum a recipient of a 2008 Partnership Award. The award recognizes Mecum for his innovative strategy to increase use of and knowledge about GSFC's SpaceWire Link & Switch ("router") technology throughout the international aerospace industry.

Ted Mecum

In 2005, Mecum developed a strategic, creative plan for providing widespread access to the technology free of charge via Software Usage Agreements (SUAs). Mecum predicted (successfully) that by propelling broader reach of this ground-breaking technology, NASA could help increase adoption of the SpaceWire protocol, an international electronics standard for avionics systems. Broad use of the protocol benefits NASA and other aerospace organizations since all SpaceWire-based avionics systems will be compatible and, therefore, reusable. "The more companies we can work with to integrate SpaceWire into more aerospace applications, the better for NASA, for the SpaceWire protocol, and for the industry overall," said Mecum.

The strategy has proven successful: The router has been evaluated by nearly every aerospace organization in the U.S. since the SUA strategy was put into practice, and the wide-spread availability has resulted in reimbursable Space Act Agreements (SAAs) with several major companies, including Aeroflex Corporation, Harris Corporation, and BAE Systems.

On receiving the award, Mecum said, "I am honored to win this award and the recognition for a highly valuable GSFC technology. The approach we are using is bringing in more partnerships and reimbursable dollars than we probably would have gotten if we had gone the traditional licensing route." The Innovative Partnerships Program Office at Goddard congratulates Mecum for this honor. ■

Composites and Materials Manufacturing Technologies Featured at Annual TEDCO Event

A large audience gathered to hear presentations about more than a dozen technologies available for licensing or commercialization.

Technology Transfer Managers (such as Ted Mecum, left) were on hand to answer questions about Goddard technologies.

Entrepreneurs and business executives learned how they can capitalize on cutting-edge composites and materials manufacturing technologies developed by GSFC and NASA Langley Research Center (LaRC). The event, "Materials and Composites: Pioneering NASA Technologies Available for Commercial Application," which was supported by the Maryland Technology Development Corporation (TEDCO) and the Tech Council of Maryland/MdBio (TCM/MdBio), highlighted more than a dozen technologies available for licensing and/or commercialization.

The showcase also featured a presentation by former astronaut Robert L. Curbeam, a Baltimore native who holds the record for most spacewalks (four) during a single Space Shuttle mission. Captain Curbeam provided the audience with insight into how composites and materials manufacturing aids space missions, and discussed the progression in technology that he has witnessed throughout his career.

"Today's showcase displayed novel NASA technologies with mainstream marketplace potential," said Renée Winsky, president and executive director at TEDCO. "TEDCO is proud to again support and facilitate NASA's efforts in making public the latest innovations available for commercialization. We look forward to our continued partnership in bringing NASA technologies into the Maryland business community."

Highlighted at the showcase was Enduro Medical Technology, Inc., which successfully worked with GSFC to create the Secure Ambulation Module (SAM), a rehabilitative device that assists patients undergoing standing and walking therapy used to treat acute trauma or degenerative illness. SAM utilizes GSFC's cable-compliant joint mechanism, which facilitates subtle movement in six directions. In 2006, Enduro donated a SAM to Walter Reed Army Medical Center to aid the rehabilitation of soldiers. The company has also developed a model for children, and is in the process of testing a prototype equine version of the device for rehabilitating horses.

"Enduro Medical Technology's SAM device serves as a prime example of what can be accomplished when NASA technology is transferred and commercialized," said Nona Cheeks, Chief of GSFC's Innovative Partnerships Program (IPP) Office. "NASA takes great

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Nona Cheeks

Breaking News:

Nona Cheeks to be honored by the National Women of Color

Nona Cheeks, Chief of Goddard's Innovative Partnerships Program Office, has been selected by the National Women of Color (WOC) Science, Technology, Engineering, and Math (STEM) as one of the 2008 Women of Color All-Stars and Rising Stars of Technology. Donya Douglas, an instrument systems and aerospace engineer at Goddard, will also be honored with the award. Cheeks and Douglas were honored at the 13th annual WOC meeting, October 23–25, in Dallas, Texas. Check the winter issue of *Goddard Tech Transfer News* for more details and photos covering this exciting honor. ■

Cathy Long

As Acting Head of the Microwave Instrument Technology Branch at Goddard, Cathy Long oversees a group of innovators working on the Center's radar technology development efforts, and serves as the main technical point of contact for GSFC's new agreement with Northrop Grumman. In this interview, Long talks about her branch's work with microwave instruments and what the partnership may yield.

> "We're aligning our branch to create technologies and systems that will meet the needs of NASA missions and scientists for the next 20 years."
> — Cathy Long

Tell us a bit about your research efforts for Goddard.

My expertise focuses on microwave instruments. Much of our research has been from one gigahertz up to one terahertz, which is a broad frequency range. For years I worked in the Electrical Systems Division and supported primarily spacecraft microwave communications systems, which use microwave signals to transport data between the satellite and ground stations. I also supported microwave instrument development, and developed state-of-the-art hardware for the Differential Microwave Radiometers on the Cosmic Background Explorer.

Then, a little over 10 years ago, during the Goddard reorganization, scientists urged the Engineering Directorate to create a branch focused solely on microwave instruments. I was selected as the branch head. At that time we concentrated on building on the existing knowledge base and experience to develop technologies needed for future missions, and, in particular, the Aquarius sea surface salinity mission. Most of our technology was geared toward radiometric measurements, passively measuring microwave emissions present in the scene you are examining. More recently, we've been riding the wave of interest in active microwave measurement, which involves transmitting a radar signal, then looking at its return signal to determine what's present in the scene of interest. Microwaves are of great interest in remote sensing of planetary atmospheres and surfaces. Shorter wavelengths will hit a particle and bounce off. Microwaves, because of their longer wavelengths, can penetrate through clouds, dust and larger particles, allowing for greater depth penetration. For example, a good portion of the Martian surface is covered with a thick layer of dust. Microwaves can be used to penetrate the dust and create an image of the surface below the dust.

We've worked closely with scientists over many years and have developed quite a few research instruments, both ground-based and for aircraft. I've been leading the effort to transfer some of these technologies to space flight applications.

And what has been your experience in transferring these technologies for space flight?

Conventional radar instruments are very large, very heavy, and use a lot of power. In an airplane, we can have a radar instrument weighing 400 kg and drawing 300 to 400 watts. However, to meet the demands of future space missions, the radar weight and power must be significantly reduced to about 50 kg and 50 watts. Our challenge is to reduce the size and power of the instrument without reducing performance.

At Goddard, we've focused on antenna developments, such as digital beam-forming techniques and data processing techniques. These technologies significantly lower the power use and size of the overall system, and at the same time offer greater system flexibility by operating in different modes and across multiple bands with one system. To leverage our resources and take advantage of radar technologies developed by private industry for defense systems, we put out a partnering opportunity, and Northrop Grumman Corporation (NGC) responded.

photo credit: Bill Hrybyk

How is Northrop Grumman positioned to help Goddard achieve these goals?

Well, NGC is a major defense contractor with years of experience developing radar systems. The communication between U.S. civil and defense developers has been poor in the radar arena. But I am confident that the Space Act Agreement (SAA) we signed with NGC earlier this year will be a catalyst for developing radar remote sensing systems that will allow us to measure scientific parameters with greater resolution. NGC is interested in sharing technologies with us and in infusing some of the technologies we've already developed into the end result, rather than insisting on providing a complete instrument, as large companies typically want to do.

We're aligning our branch to create technologies and systems that will meet the needs of NASA missions and scientists for the next 20 years. Some program managers and scientists are skeptical that a space-flight radar instrument on the order of 50 lbs. and 50W can be developed to meet performance requirements within current cost constraints. But the SAA with Northrop Grumman will allow us to develop and demonstrate this technology. We'll be able to show others the data collected, which will build confidence and trust from the outside community in Goddard's capabilities and the advantages we can bring to mission-level development.

Why do you need a Space Act Agreement to make that possible?

For one thing, a partnership with a leading radar developer allows us to be more competitive in the proposal selection of technology developments we do in our branch. Part of my role as a branch head is to look strategically at what NASA and Goddard want to achieve—and then align our technologies and talent with those goals. We don't want to recreate what's been done, and we want to use our resources wisely, investing in those key component and subsystem technologies that are enabling. The SAA allows us to combine resources and take advantages of NGC's technologies. It's a quicker, more cost-effective approach to developing all the pieces needed for a complete system.

The process is a little more complicated when you start working with a partner outside your organization. It requires more coordination, oversight, security clearances, and infusion of technologies to create instruments that specifically address NASA's mission needs. And the benefit to NGC can take years.

A partnership through a Space Act Agreement gives us a little more leverage internally to spend time working on the technology infusion. All of us have allocated projects to work on. Without an official partnership agreement in place, we would have difficulty allocating time to discuss, to plan, to meet. With an agreement, we can pull some of our technical people into the discussion without worrying about how we'll cover their time.

But the real purpose is so that we can develop these systems that will reduce the cost for NASA and enable more science. With technology that is smaller, lighter, more energy-efficient and cost-effective, less spacecraft resources are required. Combining two major players—NASA and Northrop Grumman Corporation—gives us more clout, and people outside of our organizations will pay attention.

What intrigues you most about of the partnership with Northrop Grumman?

I'm particularly excited about combining NGC's radar technology with our remote sensing capabilities. The technology we develop can be used to explore and investigate unseen planetary surfaces, such as craters on Mars,

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photo credit: Bill Hrybyk

Cathy Long

code: **555**

years with NASA: **22**

field of research:
Microwave instruments

birthplace:
Hughesville, MD

education:
MS in Electrical Engineering, George Washington University

BS in Electrical Engineering and BS in Behavioral Sciences/ Hearing and Speech, University of Maryland

Outstanding Innovators Recognized for New Technology Reporting

Nona Cheeks welcomes the attendees of the 2008 Annual NTR Program

Dennis Andrucyk encourages innovators to make new technology reporting a priority

Andrew Petro discusses how the IPP helps increase Goddard's value through technology infusion, innovation incubation, and partnership development

Keynote speaker Tom Green gives the audience some insights into ongoing technology transfer success between Goddard and his company, designAmerica

> "We're here today to celebrate and learn from the success that can be achieved through New Technology Reporting. This, of course, is critical to launching our technology transfer activities, which can benefit Goddard, NASA, yourselves, and the taxpayers."
> — Nona Cheeks, Chief, GSFC's IPP Office

Hosted by Goddard's Innovative Partnerships Program (IPP) Office, the 16th annual New Technology Reporting (NTR) Program was held May 14 at the Newton White Mansion in Mitchellville, MD. Attendees included Goddard innovators, partners, and managers who gathered to recognize the technology transfer achievements of their peers, and to learn how new technology reporting results in successful technology transfer collaborations or partnerships.

"We're here today to celebrate and learn from the success that can be achieved through New Technology Reporting," said IPP Office Chief Nona Cheeks. "This, of course, is critical to launching our technology transfer activities, which can benefit Goddard, NASA, yourselves, and the taxpayers."

Dennis Andrucyk, Deputy Director of Engineering, emphasized the importance of filing new technology reports to protect new technologies and to demonstrate Goddard's technical capabilities. Andrucyk encouraged innovators to make reporting NTRs a priority in order to strengthen and protect the value of Goddard's innovations.

Andrew Petro, Program Executive for IPP's Innovation Incubator, echoed Andrucyk's remarks. Petro highlighted how the IPP helps increase Goddard's value through technology infusion, innovation incubation, and partnership development.

More information about IPP's Innovation Incubator is available online: http://ipp.nasa.gov/innovation_incubator.htm

Tony Maturo, Deputy Director of NASA's Academy of Program and Project Leadership, also presented data showing the significant increase in the number of Inventions and Contributions Board (ICB) Awards given to Goddard. This increase demonstrates Goddard's commitment to new technology reporting and to adding valuable technologies to the NASA portfolio. By May 2008, Goddard expected more than $104,000 in ICB awards, Maturo said—more than double the amount awarded by this time last year. NASA Chief Engineer Mike Ryschkewitsch also offered his own words of congratulations for an impressive and substantial success in ICB awards during the last year.

Keynote Presenter Focused on Long-Term Technology Transfer Success

President of designAmerica and keynote speaker, Tom Green, provided the audience with an excellent example of the growing value of Goddard technologies by highlighting the ongoing successful relationship between Goddard and his company.

During the 1990s, designAmerica participated with Goddard in the development of the Advanced System for Integration and Spacecraft Test (ASIST) technology—a real-time command-and-control system for spacecraft development, integration, and operations. The company licensed ASIST from Goddard in October 2003, making it available as a commercial off-the-shelf (COTS) product (http://dai-asist.com/). Today, ASIST has become the ground system of choice for successful satellite and instrument projects, and has significantly contributed to the small company's growth.

Green pointed out the value of this technology transfer success for small companies like his. "I would like to thank and recognize all the people from the IPP and legal offices," said Green. "It is a tough job to brew up tech transfer success from that big cauldron called technological innovation. It takes keen insight and prescience, more than a little wisdom, and perhaps even a little helpful buffering from time to time for small companies like mine."

Rick Obenschain (right) presents Stephanie Getty with the prestigious Kerley Award.

Kerley Award Goes to Stephanie Getty

Dr. Stephanie Getty's innovative work with nanomaterials has received plenty of attention within and beyond NASA in recent years. And at the 2008 NTR Program, her exceptional dedication to technology transfer efforts and new technology reporting were also recognized as she received the prestigious James Kerley Award. Named for an innovator and teacher with a 32-year tenure at Goddard, the award is given annually to an innovator who exemplifies Kerley's commitment to technology transfer.

"Dr. Stephanie Getty has shown a tireless commitment to technology transfer since she first joined us at Goddard about four years ago," said Goddard Deputy Director Rick Obenschain, who presented Dr. Getty with the award. "But [her] clear commitment to technology transfer goes beyond filing NTRs and supporting partnership agreements. She also helps promote Goddard technologies to outside organizations."

In accepting her award, Dr. Getty commented on the importance of attending external events with support from the IPP Office. "I am grateful to the IPP Office for giving me the opportunity to participate in a wide variety of meetings, technology transfer forums, conferences, and workshops." Getty said the opportunities gave her insights into commercial opportunities for the technology areas in which she works.

Patent Recipients Honored

Goddard patent attorney Christopher Edwards honored the Goddard innovators who had technologies patented in the last year, many of whom were in attendance. The IPP Office congratulates the following patent recipients: Richard Burns, Frank Cepollina, James Corbo, Jill Holz, Nicholas Jedhrich, John Vranish, John Degnan, Milton Davis, Eliezer Ahronovich, and Russell Roder. ■

Looking Ahead: **Technology Transfer Training Emphasized**

The primary message throughout the NTR Program was the importance of filing NTRs. "In the IPP Office, we're always here to help you find ways to apply Goddard technologies within and beyond NASA," said Nona Cheeks. "But as you've heard, we really do need your help. This all starts with filing the NTR."

Cheeks encouraged attendees to learn more about the NTR submission process by attending technology transfer training.

Introduction to Technology Transfer

December 16, 2008, 9:00 am–12:00 pm, Bldg. 1, Room E100E

All NASA civil servants and contractors are welcome and encouraged to attend. The course is held in Goddard Building 1. Civil servants can register online at **https://satern.nasa.gov**. Contractors can register by contacting the IPP Office's Dale Clarke at 6-2691. ■

Goddard's IPP Office is pleased to announce the recent signing of several new agreements.

Partner	Technology/Focus	Agreement type	NASA Benefits/Goals
a.i. Solutions, Inc.	Building of a framework to integrate components onto Goddard's Mission Services Evolution Center (GMSEC) bus	Space Act Agreement	The integration of components such as the Goddard Trajectory Determination System will reduce the cost of ground-based aerospace mission operations for NASA.
Bureau of Indian Education	Advancement of the educational needs of American Indian and Alaskan Native populations in science and technology	Space Act Agreement	The agreement will contribute to NASA's goals of attracting and retaining students in science, technology, engineering, and mathematics disciplines, and strengthening the diversity of NASA and the nation's future workforce.
Princeton Plasma Physics Lab	Design of a custom rotary encoder scale	Space Act Agreement	The agreement will ultimately enable PPL to build a high-accuracy wavelength calibration spectrometer, which may benefit NASA missions.
Space Exploration Technologies Corp.	Verification of mission and safety critical software	Space Act Agreement	NASA will provide Independent Validation and Verification (IV&V) services of mission and safety critical software elements provided by SpaceX, benefiting the International Space Station and potentially other NASA missions.
Aerius Photonics LLC	Development of new in-house bump-bonding techniques using detector arrays and multiplexers provided by Aerius	Space Act Agreement	NASA will gain experience and new capabilities without incurring the costs of procuring detectors and multiplexers.
Science Research Labs	Development of an optically read thermal imager	Space Act Agreement	NASA will provide support for the development of the imager and hopes to use the technology in future missions.
Advanced Powder Solutions	Optomechanical fabrication testing	Space Act Agreement	Optomechanical characterization of materials will help further technology maturation for possible use in space-based applications for missions including the International X-ray Observatory (IXO), formerly known as Constellation-X.

TEDCO *(continued from page 3)*

pride in seeing our initial technologies being taken to the next level, and today's showcase will undoubtedly facilitate future success stories with local businesses and entrepreneurs."

Marty Waszak, Deputy Director of the Advanced Planning and Partnership Office at LaRC, said the event also supported Langley's partnership efforts. "We're excited about the opportunity to collaborate with innovative companies and share technologies developed at Langley to help create better products for the American public."

Other novel technologies available for commercialization and featured at the event included:

Portable, Low-Cost Nondestructive Materials: A nondestructive method for evaluating degree of cure, variations in chemical composition, and defect states in resin-based composites and metal oxides.

Highly Reflective Coatings: A method for applying highly reflective coatings to lightweight composite panels with extremely low thermal expansion that can withstand temperature fluctuations from –115°C to 65°C.

NanoCompass: A patent-pending, lightweight, low-power magnetometer based on a single-walled carbon nanotube (SWCNT) network. The sensor's dimensions are nanoscale, allowing for new capabilities in magnetometry.

"The information presented at today's showcase highlighted technologies that benefit a wide range of individuals from astronauts to engineers to veterinarians," said Julie Coons, CEO of TCM/MdBio. "The TEDCO/NASA/TCM partnership is crucial in fostering commercialization and technology transfer so that all Americans continue to benefit from the latest and greatest innovations." ■

Goddard Licenses Technologies to Ocean Tomo for Sale In Live IP Auction

Getting space program technologies into the hands of companies that can commercialize them to benefit taxpayers is the goal of a new exclusive license agreement signed July 22 between Goddard and Ocean Tomo and administered by GSFC's Innovative Partnerships Program (IPP) Office.

Based in Chicago, Ocean Tomo is a small business that sells patented technologies through live intellectual property (IP) auctions, enabling winning bidders to commercialize the IP. Licensing government-owned patents through a live-auction process is a highly novel approach to partnering, and Goddard's participation in Ocean Tomo's auction will be the first time a federal laboratory has participated in such an event.

"The Innovative Partnerships Program Office at Goddard is charged with helping identify novel arrangements, like this one with Ocean Tomo, to bring technologies to the marketplace quickly," said Nona Cheeks, Chief of NASA Goddard's IPP Office. "This is a perfect example of how we are working to find innovative partnering opportunities that expand the utilization of NASA technologies."

> "This [agreement] is a perfect example of how we are working to find innovative partnering opportunities that expand the utilization of NASA technologies."
> — Nona Cheeks, Chief, GSFC's IPP Office

Ocean Tomo's live auction is scheduled for October 29 in Chicago. *Goddard Tech Transfer News* will offer more detailed coverage of the agreement and the upcoming auction in its winter issue. ■

Cathy Long *(continued from page 5)*

and will be useful in studying climate changes and the carbon cycle on Earth. I'm also looking forward to choreographing the talents and abilities of the people in both organizations. Years ago when I was a tap dancer and involved in Goddard's music and drama club, I was the choreographer for a few shows. I enjoyed pulling together the best of what each person had to offer, and envisioning how everything would fit together for the final product. I appreciate the fact that my work for Goddard enables me to be creative in orchestrating something beneficial to both organizations, but also to something bigger.

Do you think the agreement offers potential for spinoffs?

We have unique ideas and innovative solutions regarding antenna technologies, digital beam-forming technologies, and data processing. If we combine that with NGC's lightweight, low-power electronic technologies, we'll definitely have some system-level spinoffs.

Quite a bit of the science we do pertains to climate and weather. The technological advances can also be applied to viewing hurricanes and disaster issues in real-time, not just predicting weather changes and trends. There is great potential for one radar instrument to be used for multiple measurements and applications.

How has Goddard's Innovative Partnerships Program (IPP) Office helped with all of this?

The IPP Office has been extremely helpful with the process of creating a Space Act Agreement. I was able to focus on the technical aspects of the SAA, and the IPP Office led the effort on other issues, such as technology rights, patents that might come out of the collaboration, and the legal issues. The IPP Office was very helpful in coordination with NGC, too.

To sum up, can you tell readers why technology transfer is important to your work?

I believe it's extremely important to look not only at what we do at Goddard, but at what we can do for NASA and the nation. As government employees, we have a responsibility to keep costs down and make sure that we're providing what the country needs. We need to look at the best of what's out there and pull from industry and universities to make better, cost-effective products for NASA and the nation.

Quoting the 4-H motto I learned as a kid, we need to continue to make the best better. ■

NASA and Northrop Grumman Partner to "Measure the Immeasurable" in Climate Change and Planetary Science

Answering bold questions about life and climate on Earth and other planets is the goal behind a new Space Act Agreement signed in April between Goddard and Northrop Grumman's Electronic Systems sector and administered by NASA Goddard Space Flight Center's (GSFC's) Innovative Partnerships Program (IPP) Office.

Goddard's Laurie Leshin and Northrop Grumman's Joe Ensor sign a new Space Act Agreement at Maryland Space Day.

> "We are bringing together two of Maryland's biggest employers for a project that has major implications for NASA and our understanding of Earth and the solar system in which we live."
> — Dr. Edward Weiler, Associate Administrator for SMD

Through the agreement, researchers from the two organizations will collaborate on the development of advanced civil radar system architectures that can be leveraged into new space-based remote sensing instruments with revolutionary performance characteristics. These systems will help scientists measure with far greater accuracy, precision, and detail such things as the three-dimensional structure of Mars and other planets, as well as cloud composition and other characteristics on Earth to better understand climate change.

"We are bringing together two of Maryland's biggest employers for a project that has major implications for NASA and our understanding of Earth and the solar system in which we live," said SMD Associate Administrator Dr. Edward Weiler.

To make this technology a reality, Goddard plans to leverage Northrop Grumman's radar technology—including space-qualified electronically scanned arrays, wideband electronics, and lightweight mesh antenna technology—and combine it with its own remote sensing expertise, testing facilities, and insight into applications that would help scientists answer key space and Earth science questions.

"This is a strategic partnership that blends the best of Goddard's and Northrop Grumman's advanced sensing capabilities," said Dr. Laurie Leshin, Goddard's Deputy Director of Science and Technology. "Our goal is to expand NASA's instrument technologies, while advancing new and innovative space-based mission concepts capable of making critical science observations in support of NASA goals."

"Through this partnership, we can further develop and adapt our strong radar technologies to meet a variety of Earth and planetary science needs," said Joseph J. Ensor, Vice President and General Manager of Northrop Grumman's Space & ISR Systems Division. "By pursuing joint research and development, Northrop Grumman and Goddard will also be able to explore new climate-related opportunities that arise."

Through this collaboration, researchers at Goddard and Northrop Grumman hope to demonstrate the feasibility of a smaller, lighter, less costly radar system for science and exploration initiatives.

"The mass, power, and other requirements of current planetary radar remote sensing instruments make them extremely challenging and costly to fly to Mars and icy moons such as Europa and Titan," said Dr. James Garvin, Goddard's planetary science lead on the agreement. "Having the compact, agile, and scientifically versatile technology this agreement will produce can help us achieve entirely new, ultra-high resolution measurements of the surfaces and shallow interiors of not only Mars, but also of icy satellites, asteroids, Venus, and Mercury, in a cost-effective fashion."

Garvin went on to explain how combining forces would enable missions to measure what is currently immeasurable here on Earth and on other planets in our solar system. "For example, we think the ice caps on Mars are a virtual record book of the planet's climatic history. But in order to really understand what's written there, we need to see into the ice caps

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at much higher resolution than is currently possible. The technology we're working on would help us peel back the layers of this climate data to better address the habitability of Mars."

Not only would the systems resulting from the partnership revolutionize the study of other planets, but they would also be a huge leap forward in helping Earth scientists understand climate change and the carbon cycle on Earth.

"The current state of the art for measuring carbon biomass in forests involves measuring tree trunk diameters with tape measures," said Dr. Peter Hildebrand, Goddard's Earth science lead on the collaborative project. "Since forests are huge, we obviously have a sampling problem. If instead we could use an advanced radar system to measure this from space, it would greatly improve our ability to measure the changes in forest carbon biomass as the climate changes."

Hildebrand said that such sensing technology could also enable scientists to better understand the forces impacting climate change. "A smarter radar may be able to intelligently scan the atmosphere on the broad scale as well as concentrate more observations on areas where something important is happening, such as changes in cloud and precipitation characteristics," said Hildebrand. "We hope that this will improve our understanding of the relationship between radiation, weather, and climate, and thereby allow us to do a better job of forecasting what will happen in the future."

For example, in the current debate as to whether rising temperatures cause more intense hurricanes, Hildebrand noted, "A better space weather radar may help explain which weather systems can grow into hurricanes, and which ones will not, and also to understand how ocean and atmospheric conditions feed into the genesis of hurricanes. This will improve forecasting of hurricanes and their track and intensity."

About the partner

Northrop Grumman Corporation is a $32 billion global defense and technology company whose 120,000 employees provide innovative systems, products, and solutions for information and services, electronics, aerospace, and ship building to government and commercial customers worldwide. ■

Editor's Note: For more insight about this agreement, see this issue's profile of Cathy Long, Goddard's technical point of contact for the agreement with Northrop Grumman (page 4).

Tech Transfer Metrics

July 1, 2008 to September 30, 2008

New Technology Reports: 121

Please see the online version of Goddard Tech Transfer News for the complete list of NTRs submitted in Q4 FY08.

Patent Applications Filed: 18

Method For Monitoring Spacecraft Telemetry Via Optical Or RF Link Using Existing Upper Stage Communications System by Karl Fielhauer and Bradley Boone (both Code 553)

High-diffusivity, Low-emissivity Annular Reservoir For Pulse Tube Cryocoolers by David Gedeon (Code 600)

Neutron Imaging Spectrometer by Stanley Hunter (Code 661), and Noel Guardala (Code 661)

Nanophase Dispersion Strengthened Invar 36 by Timothy Stephenson (Code 541)

Dual Order Common Path Spectrometer by Amy Newbury (Code 410)

Spaceflight Ka-Band High Rate Rad Hard Modulator by Jeffrey Jaso (Code 567)

Optical Line of Sight Pointing and Stabilization System by Daniel Baker-Eckelkamp (Code 600)

A Double-Heated USB Drive by Mike Hinchey (Code 588)

Method And Apparatus For Second Harmonic Generation And Other Frequency Convertion With Multiple Frequency Channels by Jeffrey Chen (Code 554)

Hughes Particle Surface Interaction Model by David Hughes (Code 546)

Low-Density Parity-Check (LDPC) Encoder by Lowell Miles (Code 600) and Sterling Whitaker (Code 600)

Improved Time Delay and Distance Measurement by James Abshire (Code 690) and Xiaoli Sun (Code 690)

Broadband Planar Magic-T With Low-phase and Amplitude Imbalance by Kongpop U-Yen (Code 555), Edward Wollack (Code 665), and Terence Doiron (Code 555)

Relative Spacecraft Navigation using Reflected GPS Signals by Gregory Boegner and Ian Cohen (both Code 596)

Half-Wave Inertance Tube For Pulse Tube Cryocoolers by David Gedeon (Code 600)

Adhesive Bubble Removal Method And Apparatus For Fiber Optic Applications by John Kolasinski (Code 565)

Linear Magnetostrictive Actuator by John Vranish (Code 544)

Tooless Assembly Design For Composite Corrugated Feedhorns by Kenneth Segal, Mark Pryor, and Patrick Bonebright (all Code 543). ■

ICB awards

NASA Inventions and Contributions Board Awards

The following awards were issued by ICB during the fourth quarter of FY08.

Tech Briefs Awards

Evolvable Neural Software System by Steven Curtis (Code 695)

A Multi-Spacecraft Attitude and Trajectory Simulation by Eric Stoneking (Code 591)

Demiseable Reaction Wheel Assembly by Russell Roder, Eliezer Ahronovich, and Milton Davis (all Code 596)

A Method And System for Formal Analysis, Simulation, and Verification of Knowledge-Based Systems, Rule-Based Systems, And Expert Systems by Mike Hinchey, James Rash, Denis Gracanin, John Erickson, and Christopher Rouff (all Code 588)

4 Pass Coupler For Diode Pumped Solid State Lasers by Donald Coyle (Code 690)

T Slides by John Vranish (Code 544)

Silicon Nanowire Architecture for Uniformity in Electronic Properties and Control of Placement by Stephanie Getty (Code 541)

Computer Generated Hologram (CGH) Figure Testing Of Off-Axis Aspheric Mirrors Under Cryogenic Conditions by Victor Chambers, Raymond Ohl, and Ronald Mink (all Code 551)

A Resistively-Heated Silicon Carbide Nozzle for the Production of Molecular Beams by Cynthia Gundersen (Code 699) and Robert Abell (Code 699)

Theodolite Ring Light by David Clark (Code 547)

A Diamond Machined, Freeform Mirror for Near-IR Astronomy by John MacKenty (Code 551)

Laminated Plasma Spray Micro-Spheres by Michael Graham, Semyon Vaynman, and Melville Ulmer (all Code 551)

HDFEOS XML DTD And Schemas by Muhammad Rabbi (Code 423)

Advanced Land Image Assessment System (ALIAS) by Douglas Hollaren, James Storey, James Nelson, Edward Kaita, Reviv Levy, Lawrence Ong, Gyanesh Chander, Robert Morfitt, Dennis Helder, and Brian Markham (all Code 614)

Low Conductance Silicon Micro-leak for Mass Spectrometer Inlet by Dan Harpold (Code 699), Hasso Niemann (Code 553), Brian Jamieson (Code 553), and Bernard Lynch (Code 553)

HDF-EOS To NetCDF Convertor by Richard Ullman, Jinglie Yang, and John Bane (all Code 586)

A Diamond Machined, Freeform Mirror for Near-IR Astronomy by Raymond Ohl (Code 551)

Specialized Color Function for Display of Signed Data by Virginia Kalb (Code 600)

Software Release Awards

SpaceWire Link and Switch by Glen Rakow, Locksley Haynes, and Varsha Patel (all Code 561)

Goddard Mission Services Evolution Center Message Bus (GMSEC MB), R2 by John Bristow (Code 581) and Arturo Mayorga (Code 583)

Goddard Mission Services Evolution Center Architecture Application Programming Interface (GMSEC Architecture API) R2 by Waka Waktola (Code 583), Christopher Shuler (Code 584), Brian Gregory (Code 583), John Bristow (Code 581), Mike Butschky (Code 583), and Eric Martin (Code 583)

Goddard Mission Services Evolution Center (GMSEC) Architecture, R2 by Danford Smith (Code 581), Thomas Grubb (Code 583), John Bristown (Code 581), and James Fessier (Code 581)

HDF-EOS To NetCDF Converter by Richard Ullman, Jinglie Yang, and John Bane (all Code 586)

TARA (Toolbox for Automated Registration and Analysis) by Arlen Cole-Rhodes (Code 612)

Advanced Land Image Assessment System (ALIAS) by Edward Kaita, Reviv Levy, Lawrence Ong, Gyanesh Chander, Robert Morfitt, Dennis Helder (all Code 614)

Land Information System Software, Version 4.2 by Christa Peters-Lidard, Sujay Kumar, James Geiger, Yudong Tian, and Matthew Garcia (all Code 614)

Goddard Mission Services Evolution Center (GMSEC) GMSEC Environmental Diagnostic Analysis Tool (GEDAT) by Brian Gregory (Code 583), Christopher Shuler (Code 584), Ezinne Uzo-Okoro (Code 583), and John Bristow (Code 584)

GREAT (Goddard Mission Services Evolution Center (GMSEC) Reusable Events Analysis Toolkit) by Lamont Ruley (Code 583), James Fessier (Code 581), Zhenging Li (Code 552), Cetin Zavkli (Code 583), Tina Tsui (Code 581), Robert Wiegand (Code 581), Ryan Turner (Code 581), John Bristow (Code 584) and Sheila Ritter (Code 584)

Goddard Mission Services Evolution Center (GMSEC) Criteria Action Table (CAT) by Danford Smith, Robert Fessier, Lamont Ruley, Zhenging Li, and Chui Yeung (all Code 581)

Space Act Awards

Interoperable Remote Component (IRC) Via the Astronomical Instrument Markup Language by Carl Hostetter, Troy Ames, Ken Sall, Craig Warsaw, and Lisa Neiman (all Code 588)

SpaceWire Link and Switch by Glen Rakow, Locksley Haynes, and Varsha Patel (all Code 561) ■

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