National Aeronautics and Space Administration

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goddard tech transfer news

Goddard innovator **Glenn Rakow** received the prestigious Kerley Award at the 2007 NTR Program for his relentless commitment to new technology reporting and the technology transfer process. An internationally known leader in the field of flight electronics, Rakow's work with the SpaceWire data transmission protocol has provided tremendous benefit to many NASA missions and is accelerating its adoption by U.S. aerospace organizations. Read more about his work inside.

photo credit: Chris Gunn

in this issue:

Innovators and Accomplishments Recognized at the 2007 NTR Program

Innovator recognition, education, and presentations were on offer at the 15th annual NTR Program, held May 10 at the Newton White Mansion. More than 80 Goddard innovators, contractors and personnel gathered to recognize the importance of technology transfer. "The Innovative Partnerships Program (IPP) Office is always working to find new ways to apply Goddard technologies within as well as outside NASA through partnerships

photo credit: Chris Gunn

Goddard IPP Office Chief Nona Cheeks offered a welcome and highlighted major efforts by the IPP Office to promote technology transfer.

as well as identifying external opportunities to infuse technology needs of NASA," commented **Nona Cheeks** (Code 504), chief of the IPP Office. "[We] cannot be successful in this mission without your help—and it all begins with the new technology reports, or NTRs, and working with you in identifying technical achievements and needs."

NASA IPP Director **Douglas Comstock** also took to the podium, emphasizing goals and capabilities of the IPP and motivating staff to shift technology transfer talk from "No, we can't do this because…" to "Yes, we can do this if…"

Greg Olson gives dynamic keynote presentation

Entrepreneur and private astronaut **Greg Olson** provided further motivation and inspiration as the keynote speaker at this year's event. A proponent of NASA's Small Business Innovative Research (SBIR) program, Olson highlighted the program's benefits and his personal experience founding several businesses, many of which have been involved with SBIR. As the third private citizen to orbit the Earth aboard the International Space Station (ISS), Olson also shared tales from his trip to space, including the research he was able to participate in on board the ISS.

Editor's Note: For more information about Greg Olson, see the article in the Spring 2007 issue of Goddard Tech Transfer News.

Glenn Rakow receives prestigious Kerley Award

Named for an innovator and teacher with a 32-year tenure at Goddard and an exceptional commitment to technology transfer, the annual James Kerley Award recognizes a Goddard innovator with outstanding support for technology transfer and new technology reporting. This year, the award was given to **Glenn Rakow** for his work related to the SpaceWire protocol for data transmission in flight electronics. "Mr. Rakow was a natural choice as NASA's SpaceWire Representative. But he has taken that role far beyond expectations," said former GSFC Deputy Director **Mike Ryschkewitsch**, who presented Rakow with the award. "Mr. Rakow has worked extensively with the IPP Office to help get his innovative SpaceWire-based designs and his expertise into industry.… His commitment to technology transfer is clear: from filing NTRs for several technologies to identifying industry partners to supporting more than five Space

photo credit: Chris Gunn

Entrepreneur and private astronaut Greg Olson gave a captivating keynote speech.

Act Agreements." The IPP Office congratulates Glenn Rakow on his extraordinary efforts to help further technology transfer at Goddard. For more information about his work, see the Innovator Insights column on page 4.

Patent recipients applauded

Also recognized as part of the NTR Program were several talented Goddard innovators who had technologies patented in the last year: **Jeannette Benavides** (Code 562, retired), **Vincent Bly** (Code 553), and **Douglas Leviton** (Code 551). ■

photo credit: Chris Gunn

Glenn Rakow (center) received the 2007 Kerley Award. Pictured with AETD Director Orlando Figueroa (left) and NASA Chief Engineer Mike Ryschkewitsch (formerly GSFC Deputy Director).

NTR Corner

Jeffrey Chen

technology title:
Method and Apparatus for Second Harmonic Generation and Other Frequency Conversion with Multiple Frequency Channels (aka "Replacing Multiple Fiber Amplifiers with One for Lidar Applications Featuring Multiple Frequency-Doubled Beams")

inventor: **Jeffrey Chen** (Code 554)

case no.: GSC-15349-1

What it is: A method and design that reduces the number of optical fiber amplifiers required for laser system applications in which the desired output is high-peak-power, multiple frequency-doubled laser beams.

What makes it better: Existing multiple-beam technologies require multiple fiber amplifiers due to the inherent peak-power limitation of fiber amplifiers. This invention circumvents this limitation by enabling a single fiber amplifier to generate multiple frequency-doubled beams of short pulses with high peak power at low duty cycle, as required for many lidar missions. By using a single fiber amplifier, this technology would substantially reduce the cost, mass, size, complexity, risk, and power consumption of lidar transmitters.

How it might be used: This technology is useful for applications requiring multiple frequency-doubled laser beams of short pulses with high peak power at low duty cycle. A number of NASA missions in the formulation phase would benefit, including the National Lidar Mapping Initiative, Lidar Surface Topography (LIST) mission, ICESat-II mission, and space missions studying the icy moons (i.e., Europa, Enceladus) of outer planets. The technology would enable NASA to build instruments for these missions with greater spatial coverage and range resolution while providing the benefits noted above. The method is also suitable for applications requiring continuous-wave operation.

Tech transfer status: A patent application was filed in April 2007, and Goddard is applying for IPP Seed Funding for this technology.

File your New Technology Reports (NTRs) on eNTRe. For more information, contact Goddard's IPP Office (6-5810) or go to http://entre.nasa.gov. ■

File your New Technology Reports (NTRs) on eNTRe (http://entre.nasa.gov). For more information, contact Goddard's IPP Office (6-5810).

Glenn Rakow

> "It's so important to be in communication with the [IPP] Office, and take an active role in the NTR and commercialization process."

Tell us a bit about the research you've been doing for Goddard.

For the last three years I've been working to improve the avionics architectures for spacecraft here at NASA, primarily to support a wide range of mission requirements, promote reuse, and provide higher performance systems. This effort has involved international standard development with other space agencies such as ESA, JAXA, and ROSCOSMOS, and collaborations with U.S. industry partners to develop components to infuse into Goddard missions like JWST, GOES-R, LRO, and MMS. Central to the work is SpaceWire, which is a European standard that specifies high-speed on-board network communications —scalable point-to-point serial links that form a network between chips, boards, and boxes that is low power, small, and simple to implement. But even though it is simple and loosely defined, it can also make reuse harder. I like to think of it as a piece of moldable clay because we have been working to shape it and define the layers above SpaceWire to foster reuse. Eventually we want to define systems up to the application layer, and SpaceWire is a great communication protocol to support this.

What are some of the improvements you're working on and the benefits to NASA missions?

One major improvement has been to define a standard SpaceWire packet format that is consistent for decoding because the standard permits different packet formats depending upon the type of routing address scheme used. This new format now supports the development of standard protocols through the assignment of protocol identifiers. As a result, several new protocols have been developed. One protocol performs reliable packet delivery that will be used by the GOES-R mission. Another defines memory mapping of packets, which is useful for replacing standard parallel backplanes to increase reliability and reduce mass and power while standardizing transactions between boards and subsystems no matter their location. MMS will use this. I also recently led an international team of engineers to develop the hardware plug-and-play features to support software's discovery of a network and notification when devices are added or removed. This will first be used by AFRL (Air Force Research Laboratory) for PnPSat, which is a technology demonstration of a plug-and-play satellite that will be rapidly integrated from standard components. These changes have been incorporated above the (computer communication stack) layers that define SpaceWire.

Improvements to SpaceWire itself include adding a cable redundancy mechanism that was developed for JWST and is being used for an NRO (National Reconnaissance Office) satellite; adding the ability to fuse many discrete signals over the SpaceWire cable to eliminate extra wires for side band signaling (one pps [pulse per second] is a common example of one of these); and adding features to provide network blockage protection into our SpaceWire router design.

You mentioned standardizing to the highest level. Why is this important?

Well for one thing, avionics developments are expensive, so in order to be more competitive, we need to come up with methods to foster reuse of both hardware and software—almost as is. We seem to do the same things for every mission we build but just packaged a slightly different way and optimized for that particular mission. I think with a little forethought and buy-in from multiple projects, we could leverage efforts and come up with a scheme to reuse most of what we do. In the case of instruments that are mostly unique, we can define a higher-level interface that software can perhaps handle without too much effort.

photo credit: Chris Gunn

That all sounds like a tall order.

This is a real research project but it is worth pursuing because the potential benefits are great. With federal budget constraints we need to find ways of reducing costs to do more missions and more science—for the good of NASA and space industry in general.

What kinds of support are you getting within and outside NASA for this work?

There is a very astute team of engineers here at NASA working on SpaceWire issues to make it feasible for real missions. Examples are the physical layer connector and cable improvements led by Shaune Allen to increase the data rate and allow the cable to be broken up into several parts. A second example is the SpaceWire simulators developed by Tom Johnson and Locksley Haynes to emulate SpaceWire components. This is a real production-line effort with over 50 of these things being built and delivered to JWST and other mission customers. Another example is Mike Pagen, JWST engineer, and his work to optimize the design in field-programmable gate arrays (FPGAs) and develop solutions for some tricky implementation challenges. Omar Haddad has done an excellent job verifying our SpaceWire design so that it may be easily maintained and so that customers have confidence in it, and Chris Dailey is working on system-level issues. In addition, Pam Sullivan and Mark Voyton supported the installation of SpaceWire into the JWST Integrated Science Instrument Module (ISIM). Without the support of this whole team of talented people none of this would be possible. I am probably missing someone, which is always dangerous when you list names.

Outside of NASA we have been receiving support from other government agencies like AFRL and Naval Research Laboratory (NRL) as well as international support (mainly from ESA) to collaborate on standardization efforts. We have also had a lot of support from U.S. industry to make components to support our work.

What have you been doing with the IPP Office?

The IPP Office has been very helpful in executing Space Act Agreements (SAAs) involving SpaceWire with four different companies, which will help them integrate SpaceWire into their products. Two companies have also requested to commercialize our technology, which is in process now. And working with the IPP Office has also helped us gain a lot of exposure that we might not otherwise have gotten, through various stories, press releases, events, and just general publicity about what Goddard is doing with SpaceWire. Those efforts have definitely been extremely helpful. As an innovator, half the battle is won through education and communication, and the IPP Office is great at facilitating both. They help "grease the skids" in a lot of respects and help our efforts gain more credibility both within and outside of NASA. It's so important to be in communication with the Office about the technologies you're working on, and take an active role in the NTR and commercialization process.

Editor's note: Glenn Rakow received the 2007 Kerley Award for his outstanding technology transfer efforts. *See story on page 2.*

What do you see as the value of technology transfer and/or partnering with outside organizations in collaborative R&D?

Almost every aerospace company in the country has requested and worked with or evaluated our SpaceWire router design. As these aerospace companies adopt the design, it will streamline the interfaces and architectures across the industry. NASA can then leverage these efforts to make our work even easier. ■

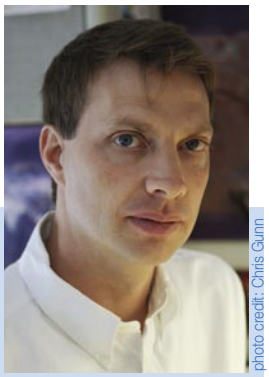

photo credit: Chris Gunn

name: Glenn Rakow

code: 561

years at NASA: 18

field of research: Avionics Systems

birthplace: Washington, D.C.

education: B.S. Electrical Engineering, University of Maryland, 1988; M.S. Electrical Engineering, George Washington University, 1999

SBIR/STTR Program to Emphasize Technology Infusion

Jim Chern leads Goddard's SBIR/STTR efforts.

The Innovative Partnerships Program (IPP) at NASA Headquarters has changed the structure and execution of the Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) programs. These programs are designed to stimulate technological innovation in the private sector to meet federal research and development needs.

The changes to SBIR/STTR are designed to achieve two objectives:

- To better enable technology infusion into NASA's programs and projects
- To increase efficiency of operations, allowing resources to be applied to other important activities

As articulated by NASA IPP Director **Douglas Comstock**, "These decisions were made in the context of the Agency priority to provide new focus on innovation and technology infusion."

> "Even though Goddard researchers are not eligible for SBIR/STTR funding, they should see if their technologies align with the topic areas. Where there's a match, there's potential for NASA use of the innovation."
>
> — Jim Chern

Program consolidation

The ten offices that had implemented the administrative and technical aspects of the SBIR/STTR program at each Center have been consolidated to four. These four "primary" Centers are aligned with the four Mission Directorates: Aeronautics Research (Glenn), Exploration Systems (Langley), Science (JPL), and Space Operations (Ames). In addition, these Centers also are responsible for needs that cut across multiple directorates, including communication (Glenn) as well as small satellites and human life sciences (Ames).

The remaining six Centers will not have to manage any administrative processes. Rather, as supporting Centers, they will work to establish and maintain close working relationships with the programs and projects at the Center, focusing on promoting and facilitating the infusion of SBIR/STTR technology into NASA missions.

Consolidating administrative processes from ten to four Centers will result in budget savings that can be applied to the development of other innovative partnerships.

Changes at Goddard

The Agency program management office (PMO) Level II for SBIR/STTR, which had been located at Goddard, has shifted to Ames Research Center. Yet Goddard will still have a key role in the program as one of the six supporting Centers.

Goddard's SBIR/STTR efforts are being led by **Jim Chern**, who serves as the SBIR/STTR technology integration manager (STIM). "The STIMs at each Center serve as the key interface for all Mission Directorates, helping them access, mature, apply, and infuse SBIR/STTR technologies quickly, cost effectively, and strategically," says Chern. STIMs also provide support for assessment of IPP-sponsored technology, portfolio management, infusion strategies, and implementation of technology solutions.

Although every Center is organized differently, generally the STIMs at each Center—including Chern—will focus on technical functions:

- Technology needs identification
- Solicitation content development
- Proposal evaluation and prioritization
- Project progress monitoring
- Utilization/Infusion

"The solicitation for 2007 has come out," says Chern, referring to the list of research topics that represent the Mission Directorates' high-priority needs. When evaluating new technology reports (NTRs), the IPP Office considers the inventions relative to these research topics, looking for opportunities to "infuse" Goddard technologies in NASA Mission Directorates.

"Even though Goddard researchers are not eligible to apply for SBIR/STTR funding, they should see if their technologies align with these topic areas. Where there's a match, there's potential for NASA use of the innovation."

To view a full list of SBIR/STTR topic areas, see the online version of this article at: http://ipp.gsfc.nasa.gov/newsletter/summer_07.htm#sbir_sttr-program.

For more information about the SBIR/STTR program at Goddard, please contact Jim Chern (6-5836 or Jim.Chern@nasa.gov) or visit www.sbir.nasa.gov. ■

Test your TTQ*

*technology transfer quotient

Up to par on SBIR

Test your knowledge of NASA's SBIR process with these true/false questions.

1. ***Small businesses that participate in the SBIR program do not need to submit a New Technology Report (NTR).***
2. ***When submitting an NTR, a contractor can use the online eNTRe system.***
3. ***Companies with an SBIR contract can submit an NTR at any time during the contract effort.***
4. ***An NTR is the only report required before closeout of an SBIR contract.***
5. ***Final payment is made within 30 days of SBIR contract closeout.***

Answers:

1. FALSE. SBIR contract clauses as well as NASA Policy Directive 2091.A require all companies participating in an SBIR contract to complete an NTR for any innovations developed under the contract.
2. TRUE. eNTRe is an online system accessible to both civil servants and NASA contractors. Point your browser to http://entre.nasa.gov/ to get started.
3. TRUE. The company can (and should) file an NTR as soon as they recognize that they have a new technology. Filing early is always best, but at the latest the NTR must be filed within 12 months of invention conception.
4. FALSE. In addition to an NTR, a Final Certified Report must be submitted to NASA upon completion of the R/R&D effort. It should cover the project objectives, work completed, results obtained, and assessments of technical merit and feasibility. Other reports and deliverables also may be called for in clauses of individual contracts.
5. TRUE AND FALSE. Final payment will be made within 30 days of contract closeout if the NTR, Final Certified Report, and any other required deliverables have been received. The last payment may be withheld if these items are not received within the required schedule. ■

REGISTER NOW

New NTR Training Date!

A comprehensive overview of when, how and why to file NTRs. A must-attend for all innovators.

Thursday, **November 15 at Goddard**

For information about this session, contact Dale Hithon at 301-286-2691 or Dale.L.Hithon@nasa.gov, or visit http://ipp.gsfc.nasa.gov/NWS-Tech-training.html.

The IPP Office's Laura Schoppe leads the NTR Training program.

new course:

Software Intellectual Property Protection and the Software Release Process

what: Learn how to protect your software innovations and share information with collaborators without compromising your work. This mini-course is designed to help civil servants and contractors understand the in's and out's of software tech transfer.

when: **August 29**, 10:00 a.m.–12:00 p.m.

where: Goddard Building 3 Auditorium (Video conferencing will be available for remote attendees at Wallops)

who should attend: Anyone dealing with software innovation and technology development, including "bench researchers" and managers

information: Contact the IPP Office's **Dale Hithon** at Dale.L.Hithon@nasa.gov

The IPP Office is pleased to announce the following new agreements:

partner	technology/focus	agreement	NASA goals/benefits
Hampton University	Handheld Sun Photometer	Non-reimbursable SAA	The collaboratively created photometer will benefit the CALIPSO and GLOBE projects. NASA hopes to patent and license the final design.
Emergent Space Technologies, Inc.	Goddard's Formation-Flying Test Bed GPS Test and Simulation Facility	Fully Reimbursable SAA	NASA will receive a facility usage fee for all non-NASA testing the company performs using the facility.
Nanotailor, Inc.	SWCNT Manufacturing Process	License	Goddard will receive royalty revenue from the sale of SWCNTs, and future nano-technology advancements resulting from the license may benefit NASA missions.
American GFM	SWCNT Manufacturing Process	License	Goddard will receive royalty revenue from the sale of SWCNTs, and future nanotechnology advancements resulting from the license may benefit NASA missions.
Lockheed Martin	GPS Receiver Testing	Fully Reimbursable SAA	NASA and NOAA may benefit from reduced risk of the GOES-R program as well as benefits for future space missions requiring GPS-based navigation.
SEGMA, LLC	KAELO Software	Reimbursable SAA	NASA can apply lessons learned to the Exploration Technology Development Program, helping researchers understand the roles of autonomous systems on the Moon. NASA will also receive payment for resources used.

SAA = Space Act Agreement

Hampton University

A new SAA between Goddard and Hampton University calls for the collaborative creation of a new handheld sun photometer to be used for the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) project jointly led by NASA and the French Centre National d'Etudes Spatiales (CNES) as well as for the Global Learning and Observations to Benefit the Environment (GLOBE) project, which is a cooperative effort of public schools in partnership with higher education and non-governmental organizations. NASA plans to patent the final design and license the technology to a company with the means to mass produce the photometers and offer them to schools participating in the CALIPSO and GLOBE efforts as well as other interested parties.

Emergent Space Technologies, Inc.

A new reimbursable SAA between Goddard and Emergent Space Technologies will allow the company non-competitive, after-hours access to and use of Goddard's Formation Flying Test Bed (FFTB) GPS test and simulation equipment and facilities. Emergent currently staffs, maintains, and operates the Facility on Goddard's behalf under a separate contract. Under this new agreement, NASA will receive a per-customer reimbursement fee for all non-NASA testing that Emergent performs using the facilities, while Emergent will save start-up and development costs by using NASA's facilities rather than investing the large amount of capital required to develop comparable facilities.

Nanotailor, Inc.

A new nanotechnology company, Nanotailor, has licensed Goddard's unique single-walled carbon nanotube (SWCNT) fabrication process with plans to make high-quality, low-cost SWCNTs available commercially. Potential markets for the technology are vast and include medicine, construction, manufacturing, imaging, and others. The license provides Nanotailor a springboard from which to grow its business, and Goddard will receive royalty revenue from the agreement.

Editor's Note: Goddard's SWCNT fabrication process was recently named a Nano 50 award winner. *See story on page 11.*

American GFM

American GFM has also licensed Goddard's SWCNT fabrication process. The company plans to add SWCNT production to its already successful business of manufacturing equipment to produce composite materials. The license will make SWCNTs even more widely available to nanotechnology commercial markets, and Goddard will also receive royalty revenue from the company's sales.

Lockheed Martin

A reimbursable SAA between Goddard and Lockheed Martin will enable collaborative testing of Goddard's "Navigator" GPS receiver, helping researchers determine whether it can meet the navigation requirements of the GOES-R program. If successful, the Navigator may help reduce operational risk for the program, and may benefit future misions requiring onboard GPS-based navigation for NASA, the National Oceanic and Atmospheric Administration (NOAA), Department of Defense, and the commercial space industry.

SEGMA, LLC

A reimbursable SAA between Goddard and SEGMA will provide NASA the unique opportunity to apply its technological expertise in the new and exciting field of business governance. Collaboration between Goddard and SEGMA will be directed toward applying an intelligent robotic system to an automated corporate governance rating system, resulting in a business intelligence tool referred to as "KAELO." Goddard will be able to apply this learning to understanding the roles of autonomous systems in the Moon's environment.

To read about other technology transfer agreements and success stories, visit:

http://ipp.gsfc.nasa.gov/success-stories.html ■

> "It's a great time to be in the nanotech industry, and NASA Goddard's process makes it an even better time for us. Through this technology transfer agreement, we'll be able to produce nanotubes with greater integrity at a lower cost. By bringing costs down while pushing quality up, we can help the industry increase adoption of this valuable technology."
>
> — Ramon Perales, President, Nanotailor, Inc.

Goddard Innovator Receives Valuable Critiques and Contacts at MIT Enterprise Forum Tech Transfer Lab

photo credit: Chris Gunn

Stephanie Getty was one of only six innovators invited to present at the MITEF Tech Transfer Lab.

Goddard innovator **Stephanie Getty,** along with members of Goddard's IPP Office, attended the MIT Enterprise Forum's (MITEF's) third annual Technology Transfer Lab on May 22. Focused on the hottest mobile technologies from university and federal labs throughout Maryland and Virginia, this year's event offered technologists an opportunity to receive valuable critiques, suggestions, and comments to help further the commercial viability of their innovations. It also offered the MITEF audience (which included venture capitalists, private investors, local companies, and entrepreneurs) exposure to new, cutting-edge technologies coming out of area labs. Getty was one of only six innovators selected by MITEF to present at the event. Her patented NanoCompass technology—a lightweight, low-power magnetometer based on a SWCNT network—was well-received by the panel of experts who provided Getty with feedback related to cost-competitiveness, finding approachable markets, and narrowing applications. "Presenting to this panel was a very valuable experience," commented Getty. "I anticipate that the suggestions, critiques, and contacts I received will be very useful as we continue to work toward commercialization of the NanoCompass."

> "Presenting to this panel was a very valuable experience. The suggestions, critiques, and contacts I received will be very useful as we continue to work toward commercialization."
>
> – Goddard innovator Stephanie Getty

Editor's Note: For more information about Stephanie Getty and her NanoCompass technology, see her profile in the Spring 2007 issue of Goddard Tech Transfer News.

Goddard Technologies and IPP Represented at SAMPE 2007

photo credit: Chris Gunn

IPP Office Director Douglas Comstock gave the keynote address at SAMPE '07 in Baltimore.

IPP personnel and Goddard innovators were among the presenters at the 2007 conference of the Society for the Advancement of Material and Process Engineering (SAMPE), at the Baltimore Convention Center June 3–7. IPP Director **Douglas Comstock** was invited to present the keynote address, highlighting the role of the IPP and technology transfer partnerships in achieving NASA's strategic goals, of which materials science plays a prevalent and important role.

Goddard innovators **Stephanie Getty** and **Betsy Pugel** were also invited to present at the conference, which boasted nearly 300 exhibitors and was attended by nearly 4,000 members of the materials science community. Getty presented information about her NanoCompass technology (see story above), while Pugel gave the audience insight into her novel non-destructive method of evaluating thermal protection system materials for use in aerospace missions.

IPP Offers a Strong Presence at NASA Day on the Hill: "Leading Today for a Better Tomorrow"

Members of Goddard's IPP Office, including Chief **Nona Cheeks**, attended the second annual NASA Day on the Hill on June 20 at the Rayburn House Office Building. The all-day event was open to members of Congress, their staffers, and the general public and featured interactive exhibits, targeted handouts, and speakers and staff from across the Agency to educate attendees and the press about current NASA operations and the importance of NASA to local communities.

As the only mission support office invited to share the day with the Mission Directorates, the IPP presented a memorable message through a popular display highlighting the importance of pursuing partnerships with the emerging commercial space sector, and demonstrating how NASA's research today will affect life tomorrow. As a result of this success, the Innovative Partnerships Program has been invited to be a part of future Day on the Hill events. ■

Goddard Technology Named Nano 50 Award Winner

Jeannette Benavides

Goddard's Method for Manufacturing High-Quality Carbon Nanotubes has been named a winner in the third annual *Nanotech Briefs*' Nano 50 Awards in the Technology category. Until recently, carbon nanotube use has been limited due to the complex, dangerous, and expensive methods for their production. However, retired Goddard innovator **Jeannette Benavides** developed a simpler, safer, and much less expensive manufacturing method. The key innovation in the patented process was its ability to produce bundles of carbon nanotubes without using a metal catalyst, dramatically reducing pre- and post-production costs while generating higher yields and greater purity.

Presented by *Nanotech Briefs* magazine—the monthly digital publication from the publishers of *NASA Tech Briefs*—the Nano 50 recognizes the top 50 technologies, products, and innovators that have significantly impacted, or are expected to impact, the state of the art in nanotechnology. The winners of the Nano 50 Awards are the "best of the best"—the innovative people and designs that will move nanotechnology into key mainstream markets.

Jeannette Benavides will receive her Nano 50 Award at a special awards dinner to be held during the NASA Tech Briefs National Nano Engineering Conference in Boston, November 14–15, 2007. ■

Federal Funding Solicitations

Search relevant labs and contacts for possible funding opportunities

Goddard civil servants and contractors can search the online Other Government Agency (OGA) Reference page on the IPP Office Web site to help identify relevant labs and points of contact at other government organizations. Through this resource, Goddard researchers can establish relationships with government organizations for technology infusion and future funding opportunities. The document covers many technology areas, including:

- Space and near-space sensors and systems
- Strategic and tactical networks
- Informational assurance

Initial submissions made through this page require only a one-page executive summary. Access the page online at:

http://ipp.gsfc.nasa.gov/funding-opps.html (see the link on the left-hand side)

For more information, please contact **Nannette Stangle-Castor** of Goddard's IPP Office at (919) 873-1457 or nsc@fuentek.com. ■

Inventions and Contributions Board Awards

ICB recognized the following software release and Tech Briefs awards for Q3 FY07:

Software Release Awards

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

Global Positioning System (GPS) Enhanced Onboard Navigation System (GEONS) by Roger Hart (NASA LRC), Anne Long, and Taesul Lee (both Code 444)

Lightware by Stephen Horan and Thomas Shay (both Code 450)

Iterative-Transform Phase-Retrieval Utilizing Adaptive Diversity by Bruce Dean (Code 551)

Wilkinson Microwave Anisotropy Probe (WMAP) Command and Data Handling Flight Software by Alan Cudmore, Timothy Leath, Art Ferrer, Jay Miller, and Steve Slegel (all Code 582), and Emory Stagmer (Code 590)

CCSDS File Delivery Protocol (CFDP) Software Library by Timothy Ray (Code 584)

User Friendly Metadata by Richard Ullman (Code 586)

Adaptive Sensor Fleet (ASF) by Jeffrey Hosler (Code 588), Troy Ames (Code 588), and John Moisan (Code 614)

Balloon Ascent: 3D Simulation Tool for the Ascent and Float of High Altitude Balloons by Rodger Farley (Code 543)

Advanced Land Image Assessment System (ALIAS) by Brian Markham, Douglas Hollaren, Jim Nelson, and James Storey (all Code 614)

NASA Forecast Model Web Map Service (NFMW) by Jeff De La Beaujardiere (Code 610)

Goddard Dynamic Simulator by Stephen Leake (Code 582)

Tech Briefs Awards

Smart, Flexible Sensory Skin With Integrated Sensors and Electronics by Jonathan Engel (University of Illinois)

Wilkinson Microwave Anisotropy Probe (WMAP) Command and Data Handling Flight Software by Timothy Leath (Code 582), Jay Miller (Code 582), and Emory Stagmer (Code 590)

For more details, contact Dale Hithon at Dale.L.Hithon@nasa.gov or visit:

http://ipp.gsfc.nasa.gov/awards-info-NASA.html ■

metrics

Tech Transfer Metrics April 1, 2007 to June 30, 2007

New Technology Reports: 24

†Software

Innovative Lightweight Structure for Mirrors and Structure by Advanced Powder Solutions

Method and Apparatus for Second Harmonic Generation and Other Frequency Conversion with Multiple Frequency Channels by Jeffrey Chen (Code 554)

Science on a Sphere Technique for Full Motion Video and Film Production by Honeywell Technical Solutions, Inc.

Enhanced 4-Meter Rigid Tri-Band Single Access (SA) Antenna Element Study by MEI Technologies, Inc.

Enhanced S-Band Multiple Access (MA) Antenna Element Study by MEI Technologies, Inc.

Compact Low-loss Plantar Magic-T with Broadband Phase and Amplitude Responses by Kongpop U-Yen, et al

GEOS-5 GCM Modeling Software† by Michele Rienecker

SpaceWire Test Set Software† by QSS Group, Inc.

Thermal Gasket, Compliant, Contamination Friendly, Electrically Isolating by Orbital Sciences Corporation

Multi-Spacecraft Dynamics Simulation for Evaluating Precision Formation Flying Control Strategies† by Richard Luquette, et al.

Material and Process for Improved Cryogenic Bonding to Invar by University of Pennsylvania

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Mission Planning Lab† by Benjamin Cervantes, et al.

Digital Corellator Module for a Direct Sequence Spread Spectrum Receiver using a Fast Fourier Transform (FFT) by LJ&T

GMI Modeling Software† by AMTI

Hughes Particle–Surface Interaction Model† by David Hughes

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Self-Adhering X-Ray Film by Michael Wilks

FPGA Implementation of a Realtime Lossless/Variable Length Compression Algorithm with a Limited Fixed Bit Rate Output by University of New Hampshire

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

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Windows to the Universe, an Educational Resource for Space Science† by University of Michigan

CUBE Instrument for 3-Dimensional Imaging Spectroscopy by Pennsylvania State University

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U.S. Patent No. 7207245: Screw-Locking Wrench by John Vranish (Code 695)

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Design of a Lightweight, Low-power Magnetometer Based on a Single-Walled Carbon Nanotube Mat by Stephanie Getty (Code 541)

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Specular Coatings for Composite Structures by Kenneth Segal (Code 543), James Lohr (Code 303), and Star Cryoelectronics

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Method of Non-Destructive Evaluation of Thermal Protection System Materials and Other Materials via Ultraviolet Spectroscopy by Diane "Betsy" Pugel (Code 553)

Improved, Flexure-Base Linear Bearing by George Voellmer (Code 543) ■

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