Goddard Space Flight Center's
Innovative Partnerships Program Office

Opening Doors, Building Capabilities

Accomplishments 2010

Opening Doors, Building Capabilities

Goddard Space Flight Center's Innovative Partnerships Program Office was awarded the Outstanding Technology Transfer Professional Award for 2010 by the Mid-Atlantic Region of the Federal Laboratory Consortium for Technology Transfer.

This award is given annually to recognize the efforts of a technology transfer professional or team who has demonstrated outstanding work in transferring technology in a manner significantly over and above what was called for in the normal course of their work.

What Are We Building, and Where Do These Doors Lead Us?

For the Innovative Partnerships Program (IPP) Office, 2010 was a banner year. We received the Outstanding Technology Transfer Professional Award for 2010 from the Mid-Atlantic Region of the Federal Laboratory Consortium for Technology Transfer. As you read about our 2010 activities in this Accomplishments Report, keep in mind that these are more than discrete transactions and activities. Equally important are the pathways we have built and the doors we have opened for better and more efficient interactions with industry and our colleagues in other federal entities. They include our outreach programs, our SBIR program, and our technology transfer activities. In addition, our education initiatives, such as the NASA OPTIMUS PRIME Spinoff Award, cosponsored by Hasbro, encourages young people to become part of the NASA workforce of the future.

In our work, we emphasize bringing NASA technology to commercial markets in ways that bring new capabilities back to NASA. An example is Dr. James Tilton's hierarchical image segmentation (HSEG) algorithm for Earth Science image enhancement. Market analysis suggested it had medical applications. An Open House targeting this sector opened the door to a partnership with Bartron Medical Imaging. Today that algorithm has been transformed into a tool to help specialists interpret medical images called MED-SEG™. During this transformation, color and additional analytical capabilities were built during the work with Barton. For scientists and engineers at Goddard, these new capabilities are now available for NASA missions. Another example is Dr. Stanley Hunter's Three Dimensional Track Imager (3-DTI). The 3-DTI is the core of the Advanced Energetic Pair Telescope, along with a Compton telescope being proposed for a future medium-energy gamma-ray mission. Working this time with a Government partner, the Naval Surface Warfare Center (NSWC), GSFC technology has been transformed into a neutron detector being scaled to fit in vehicles, ships, or aircraft and can provide a means for detecting nuclear material on ships at standoff distances. It may also have utility in other security applications, such as detecting high explosives, which are commonly used in improvised explosive devices (IEDs). (Medical imaging applications are also not far downstream.)

As we look forward to 2011, we will be emphasizing a new path: "cloud sourcing." Leveraging the blogosphere, trade shows, and targeted electronic outreach we will be building a crescendo of corporate interest leading to an open house focused on out-licensing GSFC's wavefront sensing portfolio. As part of this effort we will be promoting and opening our doors for partners to utilize GSFC's unique test and evaluation capabilities, including our new Optical Calibration Facility.

Of course, what makes our work possible is the talent, insight, and creativity of GSFC's scientists and engineers. So I close this introduction by directing your attention to the 2010 winners of the Inventions and Contributions Awards and the others highlighted in this document. Without them, there would be no success stories nor could we have won the Outstanding Technology Transfer Professional Award from the Federal Laboratory Consortium.

Nona Cheeks, Chief
Innovative Partnerships Program Office
NASA's Goddard Space Flight Center

Inventions and Contributions Board Awards

Opening Doors for Exceptional Technologies

For over 50 years, the Inventions and Contributions Board has given awards to NASA scientists for their technological contributions which build NASA's capabilities in space and open doors to the commercial sector. The IPP's awards liaison officer, Dale L. Clarke, summed up the benefits of the ICB awards program best by saying:

"Awards benefit everyone. The inventors receive recognition from their peers for their technology, and the cash prize is a nice perk. The awards help bring recognition to NASA and the individual centers for some of the great technologies that NASA is developing. Ultimately, the awards are incentives for the development of new technologies that benefit NASA and the public. By helping secure these awards for Goddard innovators and their technologies, the IPP Office continues in its mission to accelerate technology development."

Tech Brief Awards

Cryogenic Pupil Alignment Test Architecture for Aberrated Pupil Images by Brent Bos, David Kubalak, Scott Antonille, Raymond Ohl, and John Hagopian (Code 551)

Ku Telemetry Modulator for Suborbital Vehicles by James Bishop, David Newman, Nazrui Modhzaki (Code 452), and Steve Bunkdick (Code 569)

Loosely Coupled GPS Aided INS for Range Safety by Raymond Lanzi and Scott Heatwole (Code 598)

Cryogenic Scan Mechanism for Fourier Transform Spectrometer by John Brasunas and John Francis (Code 552)

GlastCam: A Telemetry-Driven Spacecraft Visualization Tool by Dean Chai (Code 600) and Eric Stoneking (Code 591)

Perl Module for Constructing Date Time Iterators by Curt Tilmes (Code 614.5)

Optimal Padding for the Two-Dimensional Fast Fourier Transform by David Aronstein and Jeffery Smith (Code 551)

Sampling Theorem in Terms of the Bandwidth and Sampling Interval by Bruce Dean (Code 551)

Method of Fabricating Radial Groove Gratings Using Projection Photolithography by Dmitri Iazikov, Thomas Mossberg, and Christoph Greiner (Code 600)

Superconducting Millimeter-Wave Bolometer Array by James Chervenak, Christine Jhabvala (Code 553), Samuel Moseley (Code 660), Edward Wollack, and Suzanne Staggs (Code 665)

Orbit Determination Toolbox by Kate Gregory, Keith Speckman, Sun Hur-Diaz, Derek Surka, Dave Gaylor, Russell Carpenter, and Kevin Berry (Code 595)

Reaction Wheel Disturbance Modeling Extraction Software (RWDMES) by Carl Blaurock (Code 600)

Gratings Fabricated on Flat Surfaces and Reproduced on Non-Flat Substrates by David Content (Code 551), Thomas Mossberg, Christoph Greiner, and Dmitri Iazikov (Code 600)

Systems, Methods, and Apparatus of a Nitinol Valve by Rebecca Gillespie (Code 695)

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

GMSEC ANSR by Everette Cary, Robert Antonucci, Joseph Gurganus, and Peter Hitchener (Code 583)

The Small Deflection Energy Analyzer (SDEA) by Fred Herrero (Code 553)

Cloud Water Content Sensor for Sounding Balloons and Small UAVs by John Bognar (Code 600)

Small Bolt Torque Tension Tester by Alan Posey (Code 543)

Agora: A Comprehensive General-Purpose Simulation of Attitude and Trajectory Dynamics and Control of Multiple Spacecraft by Eric Stoneking (Code 591)

Ground and Space Radar Volume Matching and Comparison Software by Kenneth Morris and Matthew Schwaller (Code 422)

Adaptable Gratings with Wavefront Transformation Functionality by Dmitri Iazikov, Thomas Mossberg, and Christoph Greiner (Code 600)

Focusing Diffraction Gratings Element with Advanced Aberration Control and Wavefront Transformation Properties by Thomas Mossberg, Dmitri Iazikov, and Christoph Greiner (Code 600)

Perl Module for Constructing Iterators from Hashes by Curt Tilmes (Code 614.5)

Discrete Fourier Transform (DFT) Analysis in a Complex Vector Space by Bruce Dean (Code 551)

Optimal Padding for the Two-Dimensional Fast Fourier Transform by Bruce Dean (Code 551)

Hybrid AlGaN-SiC Avalanche Photo-Diode (APD) for Deep UV Photon Detection by Fred Herrero (Code 553), John Sigwarth, Shahid Aslam, and Akin Akturk (Code 670)

Large Format AlGaN P-I-N Photodiode Arrays for UV Imagers by David Franz (Code 553) and Shahi Aslam (Code 693)

Visualization in Real-Time Experiment (VIRTEx) by Benjamin Cervantes (Code 589)

Null Lens Assembly for X-ray Mirror Segments by David Robinson (Code 543)

From left: Milelene Gunyon and Dale Clarke

Continuous Integration Laser Energy Monitor by Jeremy Karsh (Code 564)

Global Precipitation Mission (GPM) Visualization Tool for Validation Network Geometrically-Matched Ground- and Space-based Radar Data by Kenneth Morris (Code 613), Matthew Schwaller (Code 587), and Liang Liao (Code 613.1)

Award Winning Technologies

Micro-Slit Collimators for X-ray/gamma-ray Imaging by Michael Appleby, Iain Fraser, and Jill Klinger (Code 682)

Magnetometer for Calibrating Jovian Fields by Eric Corsini and David Hovde (Code 600)

A Novel Volumetric 3D Display System with Static Screen by Jason Geng (Code 600)

Thermally Conductive Tape Based on Carbon Nanotube Array by Ali Kashani (Code 600)

Patent Application Awards

Methods of Determining Complete Sensor Requirements for Autonomous Mobility by Steven Curtis (Code 695)

Step-Frequency ISAR by Manohar Deshpande (Code 550)
Low-Temperature Radiometer by Michael DiPirro, Thomas Hait, and James Tuttle (Code 552)

Method of Improving System Performance and Survivability through Self-Sacrifice by Michael Hinchey (Code 585)

High Field Superconducting Magnets by Thomas Hait and Peter Shirron (Code 552)

Hybrid Architecture Active Wavefront Sensing and Control System, and Method by Tristam Hyde (Code 590), Bruce Dean (Code 551), and Lee Feinberg (Code 550)

Compact Planar Microwave Blocking Filters by Edward Wollack (Code 665)

Passively Q-Switched Side Pumped Monolithic Ring Laser by Steven Li (Code 554)

Detector for Dual Band Ultraviolet Detection by Bing Guan, Laddawan Miko, David Franz, Diane Pugel (Code 553), and Carl Stahle (Code 550)

GSFC's four ICB representatives, from left: John O. Bristow, David C. McComas, Christa D. Peters-Lidard, PhD, and Sandra A. Cauffman

Composite Primary Structures Subjected to Cryogenic and Ambient Loading Environments by James Pontius (Code 542)

Directed Flux Motor by Andrew Wilson, Katherine Strausser, and Neil Parikh (Code 600)

System and Method for Transferring Telemetry Data between a Ground Station and a Control Center by Vuong Ly (Code 583)

System and Method for Embedding Emotion in Logic Systems by Steven Curtis (Code 695)

Joint Assembly by Katherine Strausser and Andrew Wilson (Code 600)

Walk and Roll Robot by Andrew Wilson, Neil Parikh, and Katherine Strausser (Code 600)

A Two-Axis Direct Fluid Shear Stress Sensor Suited for Aerodynamic by Sateesh Bajikar (Code 600)

Spring Joint with Overstrain Sensor by Peter Phelps and Bryan Gaither (Code 602)

Board Action Awards

Pivot 2.0:Radiation Hardened, Fast Acquisition/Weak Signal Tracking GPS Receiver by Steve Sirotzky, Luke Winternitz (Code 596), and Gregory Boegner (Code 567)

Surface Interaction Model for Enhanced Particulate Distribution Analysis by David Hughes (Code 546)

Millimeter Wave Polarization Transformer by David Chuss, Samuel Moseley (Code 660), Giles Novak (Code 665), and Edward Wollack (Code 600)

An Active, Solid-state, 3-Dimensional Range Imaging System by James Blair, Vibart Scott, and Luis Ramos-Izquierdo (Code 694)

Broadband Planar Magic-T with Low-Phase and Amplitude Imbalance by Kongpop U-Yen, Edward Wollack, and Terrence Doiron (Code 555)

International Polar Orbiter Processing Package (IPOPP) by Zhangshi Yin, James Rice, John Bane, Kelvin Brentzel, Patrick Coronado, Swarvanu Dasgupta, and Glen Gardner (Code 606.3)

Software Release Awards

International Polar Orbiter Processing Package (IPOPP) by Zhangshi Yin, James Rice, John Bane, Kelvin Brentzel, Patrick Coronado, Swarvanu Dasgupta, and Glen Gardner (Code 606.3)

Core Flight Software System (CFS) Memory Manager Application Version 1 by David Hardison (Code 583) and Maureen Bartholomew (Code 580)

GSFC Mission Services Evolution Center (GMSEC) SystemAgent 2.0. by Chiu Yeung and Waka Waktola (Code 583)

Core Flight Software (CFS) Stored Command Application v.1 by Nicholas Yanchik and Maureen Bartholomew (Code 583)

Core Flight Software System (CFS) Checksum Application Version 1 by Nicholas Yanchick and Maureen Bartholomew (Code 583)

Core Flight Software System (CFS) File Manager Application Version 1 by Susanne Strege (Code 583) and Maureen Bartholomew (Code 583)

Core Flight Software System (CFS) Scheduler Application Version 1 by David Kobe (Code 583) and Maureen Bartholomew (Code 580)

Core Flight Software System (CFS) Data Storage Application Version 1 by Robert McGraw and Maureen Bartholomew (Code 583)

Core Flight Software System (CFS) Health and Safety Application Version 1 by Alan Cudmore, Maureen Bartholomew, and Alexander Schoening (Code 583)

Goddard Mission Services Evolution Center Architecture Application Programming Interface (GMSEC Architecture API) v.3.0 by Eric Martin, Vuong Ly, Rick Woods, Robert Wiegand, and Matthew Handy (Code 583)

Core Flight Software (CFS) Limit Checker Application v.1 by David Hardison (Code 583) and Maureen Bartholomew (Code 580)

LIS 5.0 by Tian Yudong (Code 614)

System and Method for Transferring Telemetry Data between a Ground Station and a Control Center by Vuong Ly and Timothy Ray (Code 584)

Ground and Space Radar Volume Matching and Comparison Software by Kenneth Morris and Matthew Schwaller (Code 422)

Core HSEG Software Package by James Tilton (Code 606)

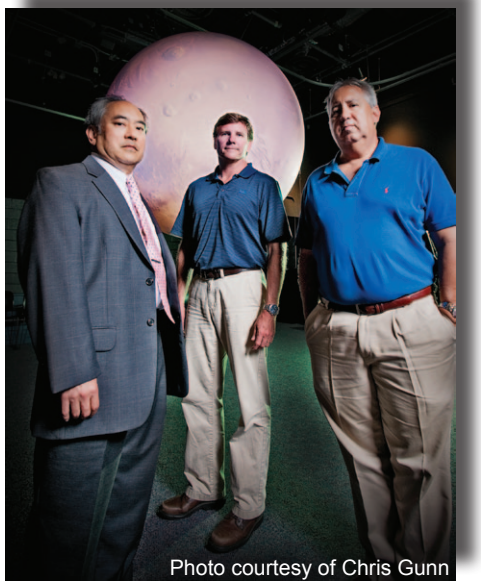
SLE Forward CLTU Service by Timothy Ray (Code 583)

Range Safety Algorithm Software Module for an Autonomous Flight by Raymond Lanzi (Code 598) and James Simpson (Code 591)

Scalable Integrated Multi-Mission Support System (SIMSS) Simulator Release 2.0 for GMSEC (Goddard Mission Services Evolution Center) by Taylor Casey, John Kim, Sarma Velamuri, and Travis Bemann (Code 452)

Promoting Development of Cross-Cutting Technologies

Goddard's Exploration Systems Project (Code 455) provides essential enabling technologies for future NASA exploration missions. By emphasizing and promoting the development and utilization of "cross-cutting" technologies, the Exploration Systems Project and the Innovative Partnerships Program Office have pursued the goal of maximizing the return on investment of taxpayer funding by reapplying and repurposing existing technologies from one application to another. Earlier this year, we interviewed Mike Weiss (Project Manager), Neal Barthelme (Deputy Project Manager), and Ron Leung (Senior Mission Systems Engineer), three senior members of the Exploration Systems Project team, to get a better understanding of what they do and why it is so important.



Left to Right: Ron Leung, Neal Barthelme, Mike Weiss

The Exploration Systems Project plays a vital role at Goddard in developing technologies for space exploration. According to Project Manager Mike Weiss, "We're the front door for Goddard's contributions to NASA's Exploration activities, providing technologies and engineering services that enable NASA to expand space exploration capabilities beyond Low Earth Orbit (LEO)." According to Mr. Weiss, a technological paradigm shift is needed on several fronts to enable future space exploration missions. "We need to move beyond current space system architectures to systems that include distributed avionics, non-satellite-based GPS navigation capabilities, cryogenic fuel management systems, advanced materials, higher data rate communication systems, and autonomous rendezvous and docking sensors and software."

One of the key aspects of the Explorations Systems Project's approach to technology development is to focus on multi-purpose technologies which can be used in a wide range of different applications, both in space and on Earth. As Senior Missions Systems Engineer Ron Leung explains, "Our experience in supporting Earth and space science missions has provided us with a lot of experience developing enabling technologies. Our goal now is to leverage that experience, and the technologies we've developed, for other applications. These can include missions within NASA, but they can also include commercial applications. We call this 'cross-cutting'."

Neal Barthelme, Deputy Project Manager, elaborated on this idea of "cross-cutting," saying, "Think of it in terms of multiuse and multifunction. If a technology we've developed for a previous mission solves a new problem, we don't have to reinvent it. These technologies developed for science missions can then 'cut across' and support other missions and applications."

The Exploration Systems Project oversees technology development in a wide range of fields, including optical communications and standards. "This type of communication architecture is the sort of thing everybody has to have. For example, right now, we really can't pipe down a lot of high-definition video from space. Optical will let us do that," said Mr. Leung. Mr. Barthelme added that these technologies could ostensibly extend the internet to distant locations such as the moon and Mars.

The Exploration Systems Project also has a track record of success when it comes to commercializing their technologies. "One of our success stories is LIDAR [light detection and ranging]," said Mr. Leung. "The technologies we've developed have been used for applications such as vegetation mapping, altimetry, and climatology, including weather prediction and global warming."

Looking to the future of the Exploration Systems Project, Mr. Weiss reiterated his commitment to developing the crucial enabling technologies that meet pressing needs, and emphasized the importance of keeping an open mind when sourcing technologies from within NASA. "As NASA expands its exploration capabilities beyond LEO, new technologies that enable both the exploration architectures and the science data return capabilities will be needed. We support the idea of 'one NASA' in which we're no longer just a collection of centers, each with one specific and separate mission, but instead we're part of this larger entity. Within that environment, any technology should be considered if it can solve a NASA problem, irrespective of where that technology originated. And once you start doing that — thinking about how something you've invented for one purpose can be applied to another — you start seeing all sorts of other possibilities for your technologies, including commercial. There are so many opportunities here; we want to take full advantage of as many of them as we can."

Exploration Systems Project Technologies

Building Capabilities for Future NASA Missions and Commercial Applications

Cryogenic Fluid Management

Cryogenic fuels, such as liquid hydrogen and liquid oxygen, have been used to power vehicles into space for over 50 years, because these propellants allow a greater percentage of the vehicle's initial mass to be devoted to payload. However, their use to this point has been limited to launch vehicles due to storage limitations inherent to cryogenic fluids, namely the fact that these fluids boil at temperatures only slightly above absolute zero. As the liquid boils, the resulting hydrogen gas needs to be vented, resulting in wasted fuel.

To address this problem, the Goddard Cryogenics and Fluids Branch (Code 552) is developing cryogenic propellant storage and transfer (CPST) technologies, such as the thermodynamic cryogen subcooler (TCS) (GSC-15603-1), to enable longer, vent-free storage times.

According to Goddard scientist Shuvo Mustafi, this system will "subcool" the liquid hydrogen to below its 20 Kelvin boiling point at one atmosphere pressure, by using a small fraction of the liquid hydrogen supplied to the propellant tank for launch to chill the bulk hydrogen in the propellant tank that will be launched. This will reduce cryogenic propellant boil-off, and deliver months of vent-free cryogenic propellant storage. Back on Earth, hydrogen is being widely hailed as the "fuel of the future," offering clean, renewable energy for applications such as automobiles and fuel cells. As hydrogen is adopted as a fuel source, the ability to efficiently store hydrogen is likely to be an increasingly important commercial need in the upcoming years. Goddard's Innovative Partnerships Program Office is currently working with the inventors in the Cryogenics and Fluids Branch to find industry partners to help continue developing these advanced cryogenic storage technologies and eventually to bring them to market.

Shuvo Mustafi makes adjustments to a model of a new Thermodynamic Cryogen Subcooling System that is being designed to enable longer space flights.

Compatibility Tools for Hardware Development

NASA missions involve a wide variety of specialized components provided by many different vendors, some of which may have been repurposed, and thus were never intended to interface with each other. For these disparate components to be successfully integrated, they must be able to communicate with any number of other components to avoid any system malfunctions or failures.

To address issues of communications compatibility, a Goddard team, headed by Program Manager Tom Jackson, has developed the Distributed System Integration Lab Communications Adapter Set (DSILCAS). DSILCAS (GSC-15501-1) uses standard IP networking to connect geographically distributed components, which natively use non-IP communication modes. This makes each component appear to the others as if they were directly linked via wired connection— even though components could be separated by hundreds or thousands of miles.

The DSILCAS system consists of two independent but associated elements: the DSIL Interface Unit (DSILIU) (GSC-15847-1) and the DSIL Communication Adapter (DSILCA) (GSC-15846-1). The DSILIU's primary function is to transfer non-IP data over an IP network, to another DSILIU. Whatever goes in one DSILIU comes out the other side on another DSILIU, reliably and in order. The DSILCA is used as a media converter between IP and link layer protocols, allowing data to be transmitted from a local or remote system via TCP or UDP, converted to raw Ethernet, encapsulated/encoded into radio bitstreams, and used to set or clear discrete signals.

Another key compatibility tool is the Gold Standard Test Set (GSTS) (GSC 15873-1). It is a turn-key software/hardware solution that offers the ability to quickly and easily verify a system's compliance with a selected subset of the C3I standard via a simple but powerful X-Windows based GUI and pre-defined test scripts.

Developing and deploying the DSILCAS and GSTS systems have provided the GSFC team with extensive experience in NASA's C3I standards, IP networking, and DSNET communications. There are numerous terrestrial applications, such as sensor and detection networks, security systems, "smart grid" control systems, and others, where various hardware and software components all need to communicate seamlessly.

By using these tools, administrators and designers of large, complex network architectures can reduce hardware risks and costs significantly by ensuring that new components will be 100% in compliance with communication protocols.

The GSTS hardware itself is housed in a portable enclosure, which contains multiple Gigabit Ethernet, LVDS/RS-422 radio, and IRIG-B interfaces.

Exploration Systems Project Technologies

Seeking Partners to Build Advanced Avionics and Communications Capabilities

As NASA makes plans for future missions beyond low Earth orbit (LEO), new communications and avionics technologies which meet the stringent requirements of spaceflight, such as scale, power consumption, data rates, broadcast range, reliability, and durability will continue to grow in their importance. Also key to NASA's plans are systems which can be expanded to remote astronomical locations as infrastructure is added, intelligent systems which can operate autonomously, and systems which use common components and architectures. GSFC has a long and successful history of developing avionics and communication systems. This experience has produced an abundance of institutional expertise which the IPP Office is currently seeking to transfer to the private sector by way of cooperative R&D and product development.

Distributed Integrated Modular Avionics

The Distributed Integrated Modular Avionics (DIMA) architecture, being developed by the Exploration Systems Projects Avionics Team, will be used to address the problems of developing reliable, consistent, and coherent C3I (communications, command, control and information) systems for future spacecraft such as the Altair Lunar Lander.

A distributed system breaks up the avionics into localized controllers, each with its own modular software dedicated to supporting those local functions. The distributed architecture will enhance system reliability by providing contingency responses, enabling independent diverse backups to primary systems, and organizing subsystems so that they are isolated via hardware and software barriers to prevent one subsystem failure from spreading.

The DIMA architecture will also support the integration of new components and system expansion, incorporation of intelligence as required, and the capability for self-healing in case of component failures. These features will reduce the time spent on costly system integration and testing as well as make the systems more reliable.

Using a distributed architecture can provide value in a number of commercial applications, including next generation "smart" electrical grids, telecommunications, air traffic control systems and many others. Some of the advantages of applying this architecture include minimizing the impact of subsystem failure and the ability to do system maintenance and perform upgrades with minimal disruption of services.

Optical Communication

Optical communication is a particularly exciting area of research and development, both in space and for commercial applications, as optical modes offer vastly higher data rates and greater security than traditional RF modes. The optical communications spectrum is also relatively underutilized on Earth when compared to traditional RF frequencies, which have become increasingly congested and thus are prone to interference problems.

Goddard is currently leading NASA's only in-space optical communications demonstration, leveraging the expertise and experience of its Optical Project Office to conduct optical vs. RF studies to determine the engineering advantages and trade-offs of each. The fruits of these experiments will hopefully one day form the basis of the next generation of wireless networks.

Disruption Tolerant Networks

Disruption tolerant networking, as the name implies, will enable the formation of networks which continue to function during delays or disruption events that would cause a break in transmission on a normal network. This functionality could prove invaluable in commercial applications, such as medical and disaster response communications, where network automation, reliability, and data integrity are essential.

Adaptive Antennas

Adaptive antennas could also provide significant value over existing technologies by expanding coverage area, providing superior link availability, margin, and data rate performance, and reducing antenna system scale and power usage. Adaptive antennas can incorporate multi-band array technology to support S, X, and Ka-band operations all from a single antenna. As wireless communication networks become increasingly ubiquitous, companies that can provide superior, high-performance antennas for their wireless product lines may be able to create a distinct competitive advantage in the marketplace.

Exploring Medical Applications for GSFC Technologies

Unlocking Doors to Critical Health Care Applications

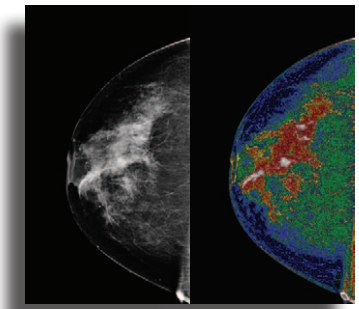
HSEG/MED-SEG™ Crossover Success

HSEG, in its native application, segments the roof tops of a residential neighborhood.

In August of 2010, the Food and Drug Administration approved an image enhancement system called MED-SEG™ for use in aiding doctors in the evaluation and diagnosis of mammogram images. The MED-SEG™ system, a product of Bartron Medical Imaging Inc., has been nearly a decade in the making. The basis of the system, Goddard scientist Dr. James Tilton's hierarchical image segmentation (HSEG) algorithm (GSC-14305-1), was initially developed to analyze satellite imagery in Earth Science applications, such as NASA's Landsat and Terra missions, with no thought of how it might translate to the radiologist's office. It wasn't until the Innovative Partnerships Program Office held a workshop for GSFC innovators and members of private industry that the utility of the HSEG algorithm as a cancer diagnostic tool was realized. As a result of the long term efforts of the Innovative Partnerships Program Office, GSFC technology has now been successfully applied to the cause of saving women's lives by enhancing early breast cancer diagnostic capabilities.

MED-SEG™ has been installed at the University of Connecticut Health Center, and other potential evaluation sites include New York University Medical Center, Yale-New Haven Medical Center, and the University of Maryland Medical Center. Currently, mammogram analysis is subject to false negatives. As a result, at-risk women are often given expensive and uncomfortable MRI's that are prone to false positives. MED-SEG™ promises to make it easier for doctors to detect and identify areas of interest in the mammogram, thereby making the test more useful and potentially avoiding unnecessary MRI's and/or biopsies.

The version of HSEG which forms the basis of the MED-SEG™ system is now four years old. While MED-SEG™ was in development, Dr. Tilton continued his work on improving and expanding HSEG's capabilities. Another possible application for HSEG is the fusing of spot LIDAR data with continuous coverage image data. This continued development of HSEG offers some interesting licensing possibilities for markets as diverse as facial recognition, image data mining, and crop monitoring. Such possibilities give a good indication of the potential value and versatility of the HSEG technology.



MED-SEG,™ based on GSFC technology, is used to identify areas of interest (highlighted in white) from a mammogram image.

Neutron Imaging:

Astronomy, Homeland Security, Medical Imaging

A device designed to detect small quantities of Special Nuclear Material (SNM) at moderate standoff distances is being examined for applications in medical imaging. Co-developed by GSFC scientist Dr. Stanley Hunter and Dr. Noel Guardala of the Naval Surface Warfare Center (NSWC), the Neutron Imaging Camera (NIC) (GSC-15024-1) is based on the results of research originally conducted at GSFC to develop the Three-Dimensional Track Imager (3-DTI) for gamma-ray astronomy applications.

The Innovative Partnerships Program Office is currently seeking industry partners to help continue the development of this astronomy and homeland security technology and harness its neutron imaging capabilities for advanced medical imaging applications. Neutrons possess inherent characteristics which could prove quite advantageous when imaging the human body. Neutrons are able to penetrate very deeply, and thus offer the possibility to image anatomical structures regardless of where there are located in the body. Neutron imaging can also be used to identify and distinguish nearly all of the various chemical elements that naturally appear in the human body. Finally, neutrons are unlikely to be destructive to delicate biological tissue, as they interact very weakly with matter, and thus may provide a safety advantage over other forms of radiation commonly used in medical imaging.

Dr. Hunter, with the support of the IPP Office, has engaged in early discussions with a medical school concerning the NIC's potential utility in medical imaging applications. Though the technologies at the heart of the NIC were developed with little consideration given to medical applications, the IPP Office has demonstrated the ability to transfer technologies across sectoral lines, as with the HSEG algorithm.

Originally designed to detect Special Nuclear Material (SNM) at standoff distances, the NIC was successfully tested by placing it on a dock with a SNM source located on a boat docked nearby.

Exploring Medical Applications for GSFC Technologies

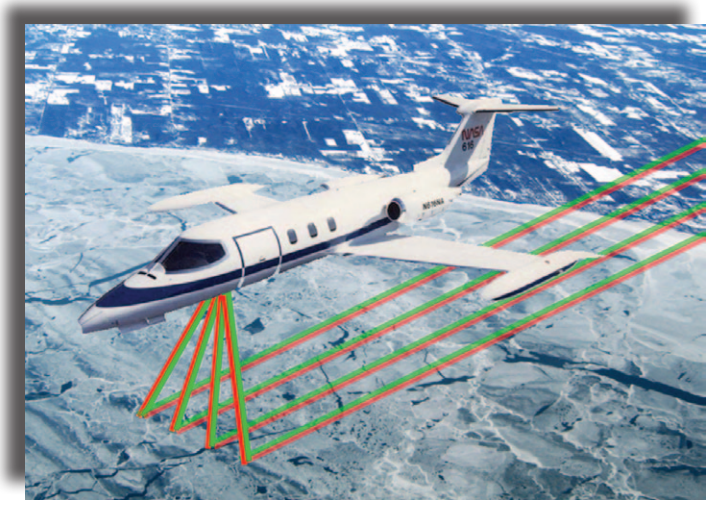
Unlocking Doors to Critical Health Care Applications

Laser Imaging

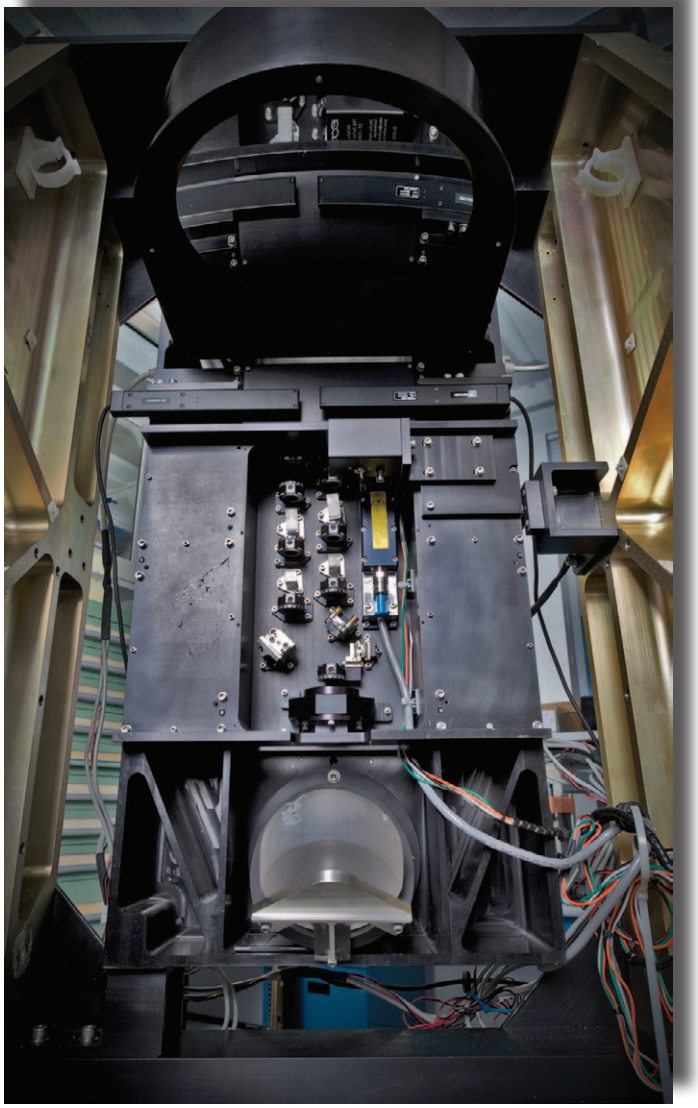
In our modern world, it is often said that information travels at the speed of light. Scientists and engineers at Goddard Space Flight Center have developed a new laser altimeter system that takes advantage of all the information that can be found in even a single photon of light. The Slope Imaging Multi-polarization Photon-counting Lidar (SIMPL), developed for Earth science and planetary mapping applications, such as the future ICESat-2 Mission, is capable of not only providing the location and shape of a given object or feature, but also of helping to identify other physical characteristics, such as the difference between water and ice, the thickness of polar ice, or the height of forest vegetation.

SIMPL uses highly precise detectors and event timers to achieve single photon sensitivity. SIMPL also contains a novel laser transmitter (GSC-15950-1) which operates at two wavelengths by frequency doubling a near-infrared micropulse laser, thereby also producing green light. After each beam is split four ways, they are polarized with parallel polarization planes. The two colors are then recombined, into four plane-polarized beams with co-aligned near infrared and green pulse energy. SIMPL is therefore able to differentiate planetary features such as water, snow and ice, as well as determine vegetation and foliage characteristics by the way a target scatters and depolarizes the laser pulses

SIMPL's developers, led by Dr. David Harding, Dr. Anthony Yu and Philip Dabney, along with the Innovative Partnerships Program Office have identified medical imaging as another potential application for their technology. For instance, a multi-polarization lidar system with single photon sensitivity could potentially be used to distinguish malignant and benign tumors based on how the target scatters and depolarizes the laser pulses. Though some forms of laser-based imaging have been used for non-invasive "optical sectioning," the integrated technologies demonstrated in the SIMPL instrument could enable instantaneous, depth-resolved, multi-wavelength, polarimetric imaging with single photon sensitivity. Though SIMPL is quite large and was designed for use on aerial and orbital platforms, Dr. Harding is confident that the components could be significantly miniaturized, making it more suitable for the clinical setting. If this can be achieved, SIMPL's underlying technology could one day offer doctors a safe, noninvasive tool with which to make important medical diagnoses.



An artist's rendering of SIMPL aboard the NASA Lear-25 collecting multi-beam, two-color altimetry data across ice-covered Lake Erie.



The SIMPL multi-beam laser transmitter mounted in the center of the optical bench and the 20cm diameter parabolic mirror (top).

Exploring Medical Applications for GSFC Technologies

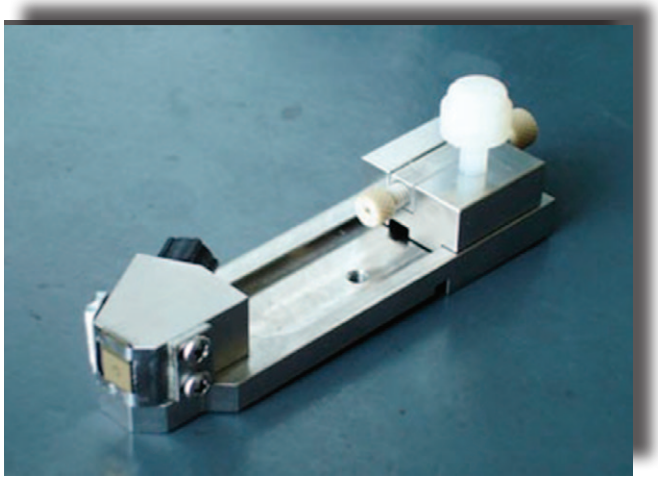
Unlocking Doors to Critical Health Care Applications

A Chip-scale Biochemistry Laboratory

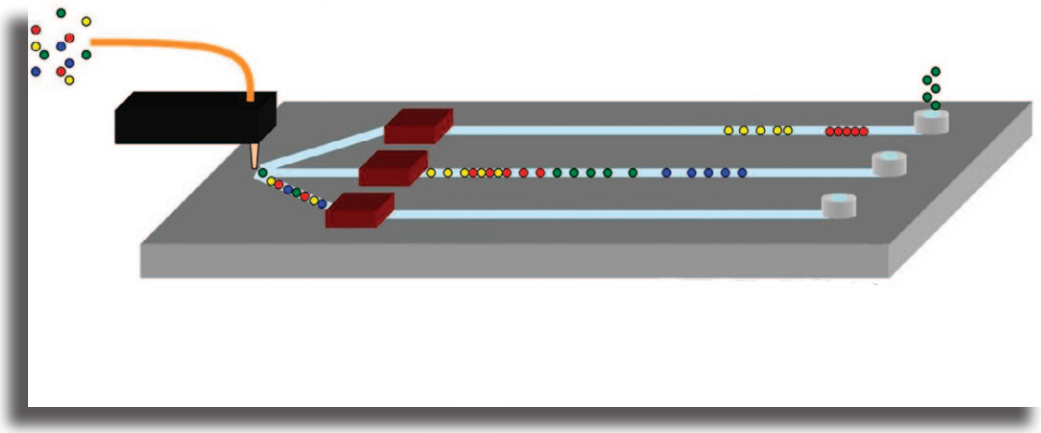
As we've been highlighting in the previous articles, many GSFC technologies offer significant value in applications scarcely related to the ones for which they were initially designed. That theme continues with the proposed In Situ Wet Chemistry Laboratory, a portable lab-on-a-chip device designed for the chemical analysis of organic molecules. Originally designed for exobiology applications— the search for and study of biological life forms beyond Earth— the In Situ Wet Chemistry Laboratory is a chip-scale biochemistry analysis device which will be able to identify biological matter such as DNA quickly and at the source. Transporting sensitive biological materials all the way back to Earth from a location such as Mars would be a cumbersome task. The same can also be said of taking biological samples in a remote region of the world, such as for water quality testing in Sub-Saharan Africa, where the preservation of the sample during its transport back to a lab is a steep and costly logistical challenge.

The In Situ Wet Chemistry Laboratory combines multiple GSFC technologies which will enable these tests to be conducted away from the laboratory and without large, expensive mass spectrometry equipment. One of the major innovations contained in this device is the Electrospray Ionization (ESI) chip (GSC-15970-1), which contains an ionization nozzle fabricated from MEMS technology on a silicon wafer. Developed by GSFC principal investigator Yun Zheng, the ESI chip will allow samples to be delivered to a miniaturized mass spectrometer (still in development) without converting them to plasma, a step which often destroys organic materials. Another key component of the overall system is the ChemFET nanoscale biological detector, which electronically detects biomarkers. The ChemFET detector has already grabbed the attention of the medical community, as developer Dr. Stephanie Getty is currently working under a grant from the NIH with the University of Maryland, Catholic University, and the National Cancer Institute to adapt the ChemFET for the detection of biomarkers associated with breast cancer.

The Innovative Partnerships Program Office is working diligently to help support the development of this technology so that one day it might have as much impact here on Earth as it will in the distant reaches of space.



The ESI nozzle (left end) is fitted onto a standard capillary nozzle holder for testing in a lab-scale, commercial LC-Mass Spectrometer.



In this diagram, the sample passes through liquid chromatographic separation and the ChemFET detector, which tests for biomarkers, and finally is sent to the mass spectrometer via the electrospray ionization nozzle.

The National Impact of GSFC's IPP Office

Some of the most important work that Goddard's IPP Office facilitates occurs beyond the boundaries of the Goddard Campus. The IPP helps to drive innovation and economic growth by partnering with other government entities, universities and small businesses. As you can see, Goddard's impact in 2010 stretched all across the nation, creating strong partnership networks and helping to create jobs and build the technological base for the economy of the future.

R&D Partnerships

Partner	Location
NASA AMES Research Center	Moffett Field, CA
NIST	Rockville, MD
US Army Research Lab	Adelphi, MD
Juxtopia	Adelphi, MD
Flight Landata, Inc.	North Andover, MA
Mindrum Precision	Rancho Cucomonga, CA
Johns Hopkins University	Baltimore, MD
Astronaut: Moon, Mars & Beyond	Albuquerque, NM
Emergent Space Technologies	Greenbelt, MD
University of Baltimore	Baltimore, MD
Schneider Optics	Hauppauge, NY
ATK Space Systems	Commerce, CA
Air Force Research Laboratory	Kirtland AFB, NM
NIST	Boulder, CO
Bureau of Indian Education	Washington, DC
Office of Scientific Research	Kirtland AFB, NM
ITT Space Systems	Rochester, NY
Sensing Machines	Laurel, MD
USC Information Sciences Institute	Arlington, VA
SpaceX Corp.	Hawthorne, CA
LogicNets, Inc.	Washington, DC
Northrop Grumman Systems	Linthicum, MD
NIST	Gaithersburg, MD
Lockheed Martin	Newton, PA
Defense Intelligence Agency	Washington, DC
Emergent Space Technologies	Greenbelt, MD
Office of Naval Research	Arlington, VA
ITT Industries	Rochester, NY
AFRL/Space Vehicles Directorate	Kirtland AFB, NM

SBIR Phase 1 2009

Awardee	Location
AdValue Photonics, Inc.	Tuscon, AZ
ADVR, Inc.	Bozeman, MT
Amplification Technologies	Brooklyn, NY
Anasphere	Bozeman, MT
Applied NanoFemto Technologies	Lowell, MA
Arradiance, Inc.	Sudbury, MA
Boulder Nonlinear Systems	Lafayette, CO
CFD Research Corporation	Huntsville, AL
Creare, Inc.	Hanover, NH
Deployable Space Systems	Goleta, CA
Discovery Semiconductors	Ewing, NJ
Emergent Space Technologies	Greenbelt, MD
Hardric Laboratories	North Chelmsford, MA
Impact Technologies	Rochester, NY
Intelligent Automation,	Rockville, MD
International Photonics Consultants	Pagosa Springs, CO
LaunchPoint Technologies	Goleta, CA
Maxion Technologies	Andover, MA
Microcosm	Hawthorne, CA
Micro-Space	Denver, CO
Neva Ridge Technologies	Boulder, CO
Novawave Technologies	Redwood City, CA
Numerica Corporation	Loveland, CO
Nuvotronics	Radford, VA
NVI	Greenbelt, MD
Open Research	Bethesda, MD
OptiGrate Corporation	Orlando, FL
Polatomic	Richardson, TX
Pulse Systems	Canton, MA
Pyxisvision	Bristow, VA
Research Support Instruments	Lanham, MD
RNET Technologies	Dayton, OH
Scientific Solutions	North Chelmsford, MA
SJT Micropower	Fountain Hills, NJ
Southwest Sciences	Santa Fe, NM
Space Micro	San Diego, CA
Space Photonics	Fayetteville, AR
STAR Cryoelectronics	Santa Fe, NM
Starodub	Kensington, MD
Structured Materials Industries	Piscataway, NJ
Superconducting Systems	Billerica, MA
Tech-X Corporation	Boulder, CO
Thoughtventions Unlimited	Glastonbury, CT
Translume	Ann Arbor, MI
Vanilla Aircraft	Falls Church, VA
Vescent Photonics	Denver, CO
Zeeko Technologies	West Lafayette, IN

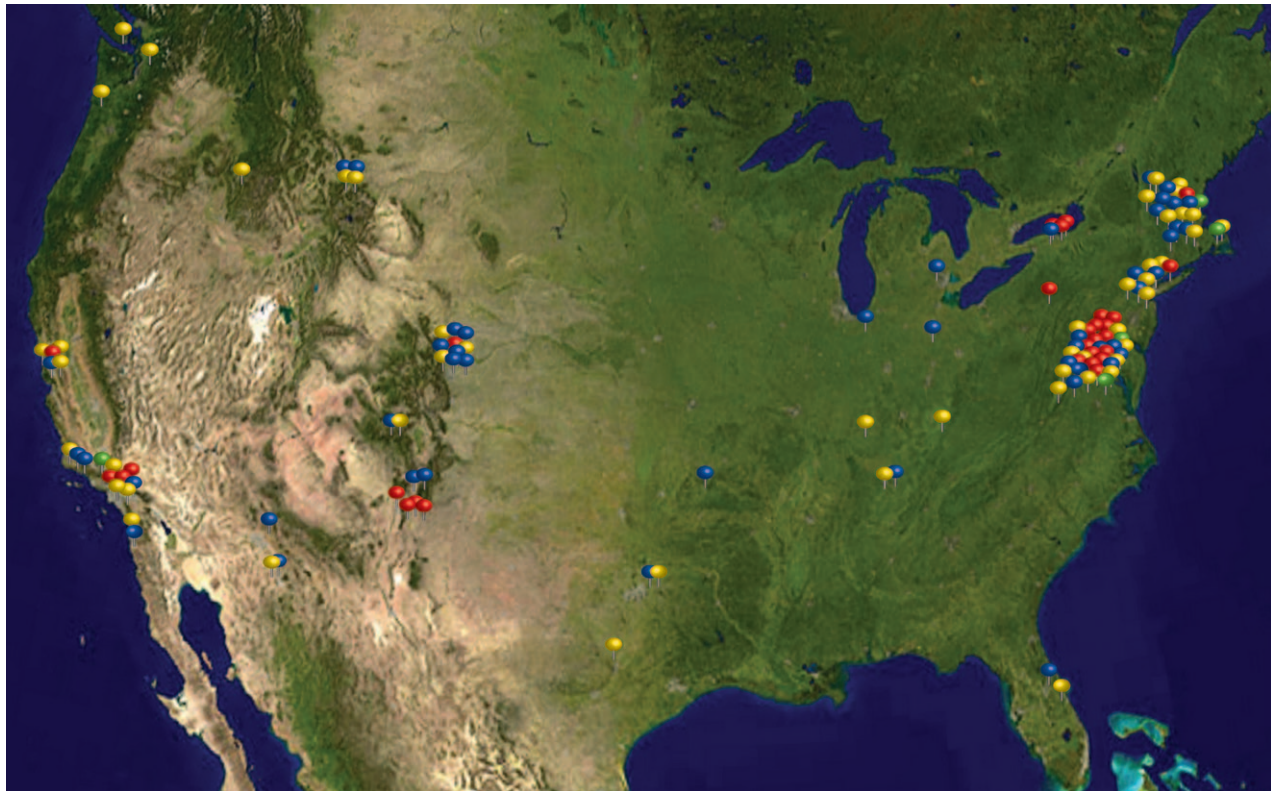
SBIR Phase 2 2006-2008

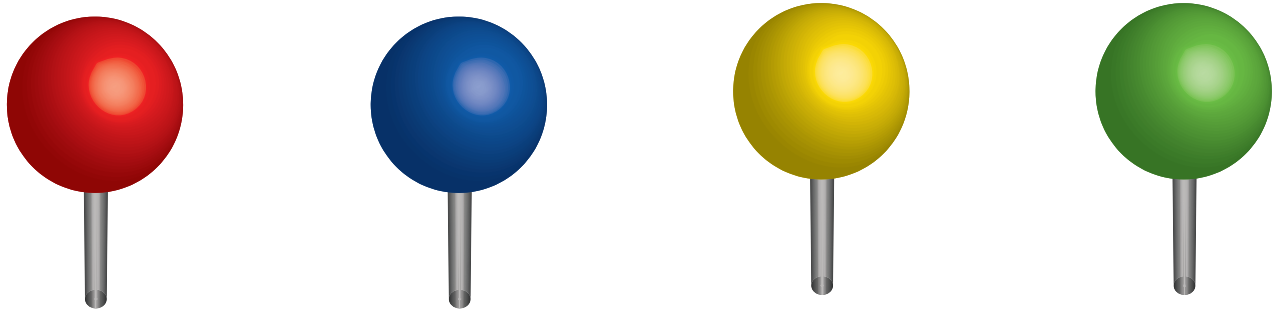
Awardee	Location
Advanced Mechanical Technology	Watertown, MA
Advanced Optical Systems	Huntsville, AL
ADVR, Inc.	Bozeman, MT
Aeroprobe	Blacksburg, VA
Anasphere	Bozeman, MT
Ashwin-Ushas Corp.	Holmdel, NJ
Atlas Scientific	San Jose, CA
Aurora Flight Sciences Corp.	Manassas, VA
Aymont Technology	Ballston Spa, NY
Coherent Logix	Austin, TX
CoolCAD Electronics	Takoma Park, MD
Creare, Inc.	Hanover, NH
Decisive Analytics Corporation	Arlington, VA
Discovery Semiconductors	Ewing, NJ
Dynamic Sensing Technologies	Amherst, MA
Dynamic Structures and Materials	Franklin, TN
Epitaxial Technologies	Baltimore, MD
Fibertek	Herndon, VA
Flight Landata	North Andover, MA

Group4 Labs	Menlo Park, CA
Hittite Microwave Corporation	Chelmsford, MA
ICs	McCall, ID
Intelligent Automation	Rockville, MD
k Technology	Langhorne, PA
Luminit	Torrance, CA
Luxel Corporation	Friday Harbor, WA
Maxion Technologies	Andover, MA
Microcosm	Hawthorne, CA
NP Photonics	Tuscon, AZ
Parabon Computation	Reston, VA
Phoebus Optoelectronics	New York, NY
Physical Optics Corporation	Torrance, CA
Polatomic	Richardson, TX
QmagiQ	Nashua, NH
Quest Product Development Corp.	Arvada, CO
RAPT Industries	Fremont, CA
Reflective X-ray Optics	New York, NY
Remote Sensing Solutions	Barnstable, MA
SciberQuest	Del Mar, CA
Sequoia Scientific	Bellevue, WA
Sigma Space Corporation	Lanham, MD
SPEC, Inc.	Boulder, CO
Summation Research	Melbourne, FL
Tai-Yang Research Corporation	Knoxville, TN
Tech-X Corporation	Boulder, CO
Toyon Research Corporation	Goleta, CA
Virginia Diodes	Charlottesville, VA
Vista Photonics	Santa Fe, NM
Voxtel, Inc.	Beaverton, OR

SBIR Phase 3

Awardee	Location
ASRC Aerospace Corp.	Greenbelt, MD
Flight Landata, Inc.	North Andover, MA
Photon Imaging	Northridge, CA
Remote Sensing Solutions	Barnstable, MA
TTH Research	Laurel, MD





R&D Partnerships

SBIR Phase 1 2009

SBIR Phase 2 2006-2008

SBIR Phase 3

Small Business Innovation Research Program Successes

Building America's Economy and Creating Jobs One Step at a Time

The Small Business Innovation Research (SBIR) program, which is administered by NASA's Innovative Partnerships Program, opens the door for small high-tech companies to participate in government-sponsored research and development. The program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet federal R&D needs, increase private-sector commercialization of innovations derived from federal R&D, and foster and encourage participation by socially disadvantaged businesses.

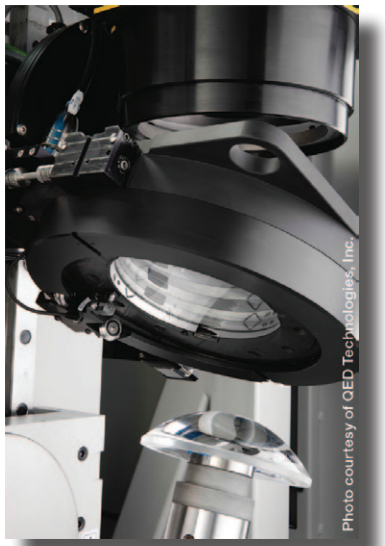
Highlighted here are five examples of SBIR contracts which have produced innovations that can benefit NASA missions and are yielding commercial success for these small businesses.

Precise Measurement of Aspheric Optics

Based in Rochester, New York, QED Technologies, Inc., developed a highly sensitive device called the Subaperture Stitching Interferometer (SSI®) for measuring spherical surfaces. This device uses a stitching technique that measures a series of sections, or subapertures, on an optical surface; compiles data from each section; and then stitches it together to obtain a complete measurement. Goddard awarded two SBIR contracts to QED to apply this same technology to aspheres, which are more difficult to measure and manufacture than spheres.

The result was the Aspheric Stitching Interferometer (ASI®), which is fast, accurate, flexible, and affordable. NASA verified the technology on a high-precision, mildly aspheric "flight optic" as part of the PICTURE/SHARPI missions.

The company's ASI® instrument, which is capable of measuring almost any optical surface, including steep aspheres, sells for $500,000, and QED Technologies has already sold systems across North America, Asia, and Europe. In addition to its benefits for NASA, the technology also can be applied to several commercial industries that require large, high-precision optical surfaces, including ground-based telescopes, lithography systems, and satellite and surveillance systems.



SSI and ASI are registered trademarks of QED Technologies, Inc.

Parallel Computing and Analytically Capable Data Mining Engine

To store and preserve the deluge of important data that results from NASA missions, NASA uses its permanent archive called the Virtual Observatory. In order to organize and make these data more readily available to the scientific community, NASA awarded an SBIR contract to SciberQuest, Inc., a leader in remote data mining technologies.

The company has helped NASA implement state-of-the-art data mining by creating an advanced computing infrastructure called Interoperable Distributed Data Engine (IDDat). IDDat acts as an add-on to the Virtual Observatory and supports processing and remote data analysis of high-volume and widely distributed data. A second piece of technology, called RemoteMiner, is a data mining engine that connects to the Virtual Observatory via IDDat and enables autonomous parallel mining of large data sets. These new capabilities provide NASA with the means to search, explore, analyze, and share data from previous spacecraft missions on site and remotely. SciberQuest is working with Goddard on an ongoing basis to provide the analytical capability to support NASA missions.

In addition to providing analytics that will enhance future NASA missions, this technology has several commercial applications. SciberQuest is already selling this software, generating a revenue stream of approximately $200,000 annually. The company continues to develop this software for use in the pharmaceutical, bioinformatics, and health care industries as well as for companies who specialize in fraud detection and network intrusion.

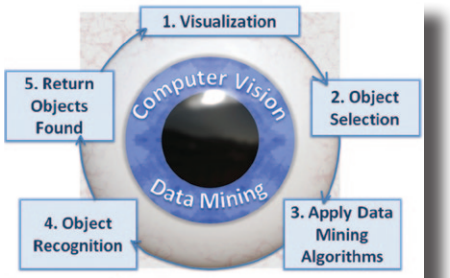


Image courtesy of SciberQuest, Inc.

Small Business Innovation Research Program Successes

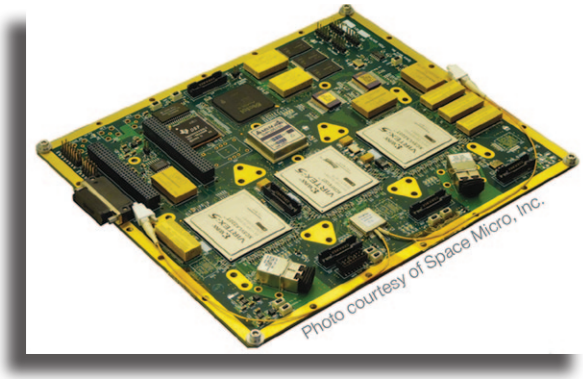
Building America's Economy and Creating Jobs One Step at a Time

Radiation-Hardened Image Processing Computer

NASA spacecraft and Earth orbiters capture world-class images that provide one-of-a-kind glimpses into our universe. However, it can be a challenge to conduct real-time image processing and storage in the harsh space environment. To address this gap in the technology, Goddard awarded an SBIR contract to Space Micro, Inc., to develop a high-performance, radiation-hardened image processing computer for use in space.

Under the contract, Space Micro developed the IPC5000™ image processing platform, which combines high-performance, low-power, radiation-hardened computing and high-speed mass memory to meet the challenges of space imaging environments. This collaboration has been an enormous success for both Space Micro and NASA, and now the Department of Defense (DoD) has a considerable stake in this technology as well. DoD awarded the company a $4 million contract to develop an image processing system for an upcoming satellite mission.

Additional applications anticipated for this image processing technology include software design radio, hyperspectral imaging, logic reconfiguration, and high-speed data transfer.



IPC5000 is a trademark of Space Micro, Inc.

In Situ Radiometers for Oceanographic Research

As NASA scientists and engineers explore the world's oceans, they require more accurate and powerful technologies for environmental surveys, vertical profiles, coastal monitoring, and remote sensing. Working under an SBIR contract, Biospherical Instruments Inc. (BSI) developed an innovative instrument called the Compact-Optical Profiling System (C-OPS). This new instrument provides unprecedented capabilities to collect high-quality data through the use of high-speed microradiometer light sensors, which may be networked into complex instruments for oceanographic studies.

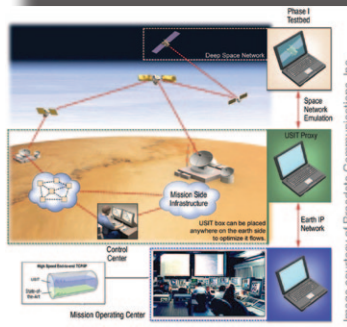
These new capabilities will greatly enhance NASA's scientific missions across the world's oceans, all while providing more accurate data, reducing uncertainties in imaging, and improving scientific understanding of interactions between the ocean and Earth's atmosphere. In fact, BSI now has a contract with NASA to support the next generation of satellite-based marine research, specifically the Optical Sensors for Planetary Radiant Energy (OSPREy) system. NASA has already purchased a number of microradiometer systems, and BSI has had numerous commercial sales outside of NASA, including to several U.S. and international universities.

Universal Space IP Transparent Proxy

When NASA needed to reduce levels of mission funding and shorten mission development schedules, Internet Protocol (IP) technologies and architecture seemed like a possible solution. However, despite their huge potential (e.g., cost effectiveness, reduced development and installation times), IP technologies encounter significant performance problems in a space environment due to narrow bandwidth, long propagation delays, large transmission errors, and unreliable connectivity.

Broadata Communications, Inc., a company specializing in IP transmission equipment, proposed a Universal Space IP Transparent (USIT) Proxy solution in response to the SBIR annual solicitation. The company's innovative network protocol employs a unique, modularized architecture that provides accurate network measurements and reconfigurations to effectively overcome IP performance problems in space links. Broadata's USIT Proxy software system provides a tenfold improvement in network throughput when compared to existing state-of-the-art IP solutions.

This innovative technology will support several NASA programs, including the IP Operational Networks, Tracking and Data Relay Satellite Systems, Deep Space Networks, beyond Earth multihop/relay communications, and direct line-of-sight near-Earth satellite communications. The USIT system has attracted customers from universities and local broadcasters, with commercial sales of $200,000 annually. It can also be used in several other commercial applications, including wireless Internet access networks, radio frequency/microwave trunking links, commercial satellite networks, mobile enterprise networking, and packet cellular networks.



Managing NASA Goddard's Intellectual Property

Opening Doors for GSFC Technologies

With so much new technology flowing through Goddard Space Flight Center, it is critical to ensure that all issues pertaining to intellectual property (IP) are kept well in order. The GSFC Office of Patent Counsel (OPC) plays a vital role in making sure that GSFC retains strategic control of all its critical technological innovations and inventions. This allows the IPP Office to more effectively manage its IP and opens doors to the commercial markets, where IP protection is critical.

Chief Patent Counsel Bryan Geurts and his office are responsible for identifying, protecting, and managing GSFC IP, as well as providing other IP legal services, for example trademark, copyright and trade secrets services. The IPP Office strongly encourages GSFC innovators to keep the OPC in the loop as they generate new technologies, with the hopes that potential problems related to matters of IP can be averted before they happen. All too often, the OPC is called upon only after an IP issue elevates to a crisis level. However, according to Mr. Geurts, this situation appears to be improving, with more inventors proactively approaching the OPC for legal advice and guidance. Hopefully this trend will continue, as the OPC plays a vital enabling role in the IPP Office's technology transfer operations.

Photo Credit: Chris Gunn

GSFC's Chief Patent Counsel, Bryan Geurts

Critical to the IPP Office's mission of making sure that the utility of GSFC technologies is maximized by NASA as well as industry, academia, and other government agencies, is the practice of new technology reporting. New Technology Reports (NTRs) serve as the official record within NASA that an important innovation has been made. NTRs are stored in a centralized database so that the IPP Office can readily locate and promote the virtues of a given technology. Every year, the IPP office carefully examines all NTRs and selects some of them for patenting. 2010 was a great year for new technologies at Goddard. For the second year in a row, the IPP Office received over 250 NTRs— a credit to the persistence of the IPP Office's efforts to promote NTR filings. From that large group, GSFC received 16 patents, which are listed below.

Patent Number	Title
7,762,155	Gear bearings
7,769,488	SMART solar sail
7,739,671	A method and system for direct implementation of formal specifications derived mechanically from informal requirements
7,752,608	A method and system for formal analysis, simulation, and verification of knowledge-based systems, rule-based systems, and expert systems
7,697,759	A split-remerge method for eliminating processing window artifacts in recursive hierarchical segmentation
7,765,171	SPAACE: Self properties for an autonomous & autonomic computing environment
7,762,523	Miniaturized double latching solenoid valve
7,746,190	Broadband high spurious-suppression microwave waveguide filter for polarization-preserving and transformer

Patent Number	Title
7,668,796	Enhancing R2D2C requirements based programming with automata learning
7,673,089	An extendible USB drive that accepts external media
7,673,089	A double-headed USB drive
7,830,527	Method and apparatus for second harmonic generation and other frequency conversion with multiple frequency channels
7,830,224	Compact low-loss planar magic-t with broadband phase and amplitude responses
7,811,406	Advanced adhesive bond shape tailoring for large composite primary structures subjected to cryogenic and ambient loading environments
7,735,385	Actuated ball and socket joint
7,817,087	Relative spacecraft navigation using reflected gps signals

Education Initiatives

Opening Doors for the NASA Scientists of Tomorrow

Another key aspect of NASA's mission is to provide educational opportunities for America's youth. These initiatives are designed to encourage young people to learn more about NASA by engaging with them on topics related to science, technology, engineering, and mathematics. Over the past year, GSFC and the IPP Office have done their part by reaching out and connecting with the next generation of potential NASA scientists.

The NASA OPTIMUS PRIME Spinoff Award contest leveraged a partnership with Hasbro to encourage youth to learn about NASA spinoff technologies. "By leveraging the similarities between the popular TRANSFORMERS character and the spinoff of NASA-developed technologies to the private sector, we had a chance to greatly contribute to children's interest in STEM—that is, science, technology, engineering, and mathematics," said Darryl Mitchell of Goddard's IPP Office.

The contest encouraged students to read NASA's *Spinoff* magazine to learn how NASA technologies transform into everyday Earth-based applications. Student contestants chose one of the spinoffs from the most recent issue of *Spinoff,* to feature in a 3 to 5-minute original video they made themselves about why the story they selected is the best NASA spinoff of that year.

Image courtesy of Hasbro, Inc.

A panel of NASA judges—one from each of the 10 field centers and one from Headquarters— evaluated the submissions according to the criteria of demonstrating proper understanding of the technology and the spinoff, persuasiveness of presentation, and originality and creativity.

"Everyone is a winner in this competition: the contestants, the innovators, the spinoff companies, and more," said IPP Office Chief Nona Cheeks. "The public gains a greater awareness of NASA's technology transfer activities as well as the importance of NASA programs and projects, the NASA researchers who develop innovative technologies used in NASA missions, and the companies that commercialize NASA technology."

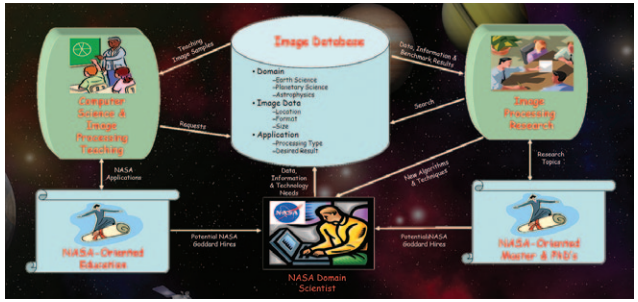
To watch the winning videos, please visit the contest's website at:

http://ipp.gsfc.nasa.gov/optimus

IMAGE SEER

Images for Science, Education, Experimentation and Research

There are a number of internet databases designed to provide detailed medical and military images for Image Processing (IP) and Computer Vision (CV) researchers. However, NASA images have traditionally been difficult for researchers to find and are often available only in hard-to-use formats that don't readily lend themselves to CV and IP.



The new IMAGE SEER database (GSC-15967-1) seeks to address this issue. Thanks to the efforts of Dr. Jacqueline Le Moigne and her team, including Tom Grubb and Barbara Milner (Code 583) as well as student interns Jihad Ashkar and Devin Miller, IMAGE SEER (IMAGES for Science, Education, Experimentation and Research) provides an easily readable database of NASA benchmark image data. IMAGE SEER enables the teaching of CV and IP on NASA data, and also provides reference data for the validation of newly developed CV and IP algorithms. This database includes a representative sampling of NASA images obtained from various Earth, planetary, and exploratory science. It also offers a web-based front end for easy access.

One of the primary goals of IMAGE SEER is to provide for better distribution, utilization, and understanding of NASA imagery data to the CV and IP university and research community. This in turn will increase the visibility of GSFC, NASA, and its missions. A potential by-product of this effort is that GSFC may be better able to attract top-level college graduates and prepare them for working with NASA data. In addition, IMAGE SEER will enable researchers to develop new CV and IP techniques around this data — research from which GSFC and NASA may eventually benefit.

http://imageseer.nasa.gov

Networking and Outreach Events

The IPP Office organizes, hosts, and attends a broad range of networking and business outreach events throughout the year in order to engage and educate innovators, program managers, the public, and potential partners about the collaborative opportunities that the IPP provides. This in turn can offer a variety of benefits — creating strategies for making GSFC-developed technologies available for licensing, leveraging technologies and capabilities from one NASA mission/project to another, and defining technology transfer best practices, to name a few. In this way, we help ensure the maximum return for the public's investment in GSFC and NASA, as space science technologies are leveraged into the private sector, fueling new products and markets that can both benefit society and create significant revenue and business opportunities.

Innovator Outreach

In order to support innovation, the IPP Office frequently reaches out to innovators, both at GSFC and across NASA, to create awareness about new technology developments and foster interdisciplinary collaboration. These efforts also include education and training exercises on topics covering all aspects of the technology transfer process.

Third Annual GSFC Science Poster Party

January 28, 2010, Greenbelt, MD

Members of Goddard's IPP Office staffed a booth at this third-annual Science and Engineering Directorate (SED) onsite event. To foster enhanced communication and cooperation between directorates for technology reporting purposes, IPP encouraged attendees to learn more about IPP's role in managing new technology reporting, outreach via NASA partnership development and success stories, and recognition for accomplishments.

IPP staff members and guests at the Third Annual GSFC Science Poster Party enjoyed the IPP Office booth, featuring new engineering and technology innovations.

Science Jamboree

June 2, 2010, Goddard Mall

The Sciences and Exploration Directorate's laboratories, branches, and offices showed off their science to the entire Goddard Space Flight Center community. Highlights of the Jamboree included: live science experiments, show-and-tell, and displays; Science Cafe seating area for chatting with colleagues, old and new; cajun lunch available for purchase; free afternoon refreshments. This was a chance to meet people in other directorates, learn about their work, and cross-pollinate ideas for interdisciplinary research. It's also a unique learning opportunity for summer interns and newly arrived scientists.

Innovator Outreach

Goddard's IPP team members moderated a panel session, gave presentations, and helped staff an exhibit booth at NASA's PM Challenge 2010.

NASA's PM Challenge 2010 "Above and Beyond"

February 9-10, 2010, Galveston, TX

Representatives of Goddard's IPP Office attended the seventh annual Project Management Challenge event. During the event, Goddard IPP team members moderated a panel discussion and gave presentations on "Innovation in Intellectual Property Management," and "Reuse of Software by Programs and Projects." This yearly event, attended by 5,000 NASA civil servant and contractor personnel, enables Goddard's IPP to showcase Goddard technology transfer and capability successes, both internal to multiple NASA missions as well as externally for commercialization and partnership development.

A Celebrate Goddard Day attendee explores the AETD Table Satellite demonstration to learn about how GSFC's spin-off technologies unite the world.

Technology Innovation and Technology Transfer Training

June 29, 2010, Goddard Building 1

Ted Mecum primarily (and Dale Clarke to a smaller extent) conducted this training which gave Goddard employees information about the IPP Office, the technology transfer process, IP management (and spinning technology out of NASA) as well as technology infusion (spinning technology or capabilities into NASA). The course also covered why technology transfer is important and how to submit New Technology Reports (NTRs).

Technology Manager Ted Mecum teaches innovators at GSFC how to submit a New Technology Report at the Technology Innovation and Technology Transfer Training.

Celebrate Goddard Day

June 24, 2010, Goddard Mall

This year's event featured entertainment provided by Goddard colleagues, Directorate exhibits, a car show, a talent show, tours, diverse food, and the first ever Celebrate Goddard Parade. This annual event is designed to highlight the diverse skills and individual differences that have made our success possible. The Goddard Mall was filled with opportunities to learn more about the many parts that make up the Goddard mission. Many of the clubs that make up the Goddard community were on the Mall as well to share information on their activities, giving demonstrations under the main tent, and welcoming new members.

Innovator Outreach

18th Annual New Technology Reporting Program

October 20, 2010, Newton White Mansion Mitchellville, MD

Keynote speaker, Jeff Smith, Chief Executive Officer and Director of Flight Landata, discusses his company's successful partnership with NASA.

The Goddard Space Flight Center (GSFC) Innovative Partnerships Program Office (IPPO) hosted the 18th Annual New Technology Reporting Program to recognize innovators who actively support GSFC technology commercialization efforts. Goddard Center and Technical management, scientists and engineers applauded patent achievements and honored the 2010 James Kerley Award Winner. The annual event recognizes leadership in technology development and the support of outreaching to industry for commercial applications of Goddard technology. Refreshments were served as Jeff Smith, President of Flight Landata, delivered a keynote on successfully partnering with GSFC IPPO to license and commercialize the Spacecube technology.

Annual IRAD Poster Session

December 2, 2010, Goddard Building 8 Auditorium

IPP Office members Ted Mecum, Enidia Santiago-Arce and Dr. Bedford Boylston demonstrate the MMO game "Moon Base Alpha" to Annual IRAD Poster Session attendees.

The GSFC IPP Office exhibited at the Annual IRAD Poster Session to participate in inreach activities involving technologies and concept studies the Center's IRAD program funded this past fiscal year. At this event showcasing R&D achievements, the IPP Office participated in opportunities to connect, share ideas and forge new partnerships that could lead to new technologies. The IPP Office aimed to reach out to attendees regarding how IPP manages partnerships that begin with New Technology Reports. IPP staff met with scientists and engineers exhibiting at the poster session to learn of the new technologies developed and ensured the submission of NTRs and identified areas where IPP can potentially help facilitate partnerships. The IPP Office distributed *Tech Transfer* and *Tech Briefs* magazines, brochures on spinoff technologies and partnership opportunities, and demonstrated the MMO game "Moon Base Alpha" to attendees as they enjoyed refreshments.

Industry Outreach

The IPP Office attends several large technology transfer meetings across the country each year. At these events, Goddard technology managers promote GSFC's capabilities, network with potential research and commercialization partners, and learn about new standards for best practices. The IPP also reaches out to small businesses to promote economic growth and create new jobs by supporting their participation in Goddard technology initiatives.

Pittcon 2010

February 28, 2010–March 5, 2010, Orlando, FL

Ted Mecum and Elizabeth Aleiner, both of Goddard's IPP Office, attended the Pittcon® 2010 conference and exposition with over 16,000 other technology professionals from over 80 countries. The Pittcon conference is the premier annual conference and exposition on the laboratory sciences, such as analytical chemistry and instrumentation. Goddard's IPP Office attended the conference to introduce new Goddard technologies, with the goal of licensing them or establishing partnerships to further the technology.

IPP Technology Manager, Ted Mecum, assists a participant visiting the Goddard booth at Pittcon 2010.

AUTM Annual Meeting℠: Building a Stronger Community

March 18-20, 2010, New Orleans, LA

Goddard IPP Chief, Nona Cheeks, attended the annual meeting of the Association of University Technology Managers® (AUTM®) organization, with 1,600 in attendance. AUTM's members represent intellectual property managers from more than 300 universities, research institutions, teaching hospitals, businesses, and government agencies. Ms. Cheeks participated in a panel discussion, presented the paper "NASA Goddard's Open Innovation," and met with industry and academic attendees to identify leads for licenses and partnerships.

Industry Outreach

Next Steps in Managing Innovation Workshop

May 12, 2010, Plymouth Meeting, PA

The Next Steps in Managing Innovation Workshop was designed to help SBIR companies advance in their Technology Readiness Levels (TRLs) in order to license and commercialize their technologies. NASA's IPP office works with businesses to develop advanced technologies to benefit NASA as well as impact commercial industry. This workshop gave businesses the opportunity to learn about avenues for partnership and about the specific technology needs of GSFC and other resources for company and technology development. Highlights for small businesses that attended included: networking with prime contractors, one-on-one meetings with GSFC Assitant Chiefs of Technology, and panels on IP management and additional partnership resources.

GSFC SBIR/STTR Program Manager Dr. Stephen Rinehart speaks to small businesses about the importance of technology development, business success, and utilization of their technologies via infusion (internal NASA use) and commercialization (technologies to the marketplace).

The 2nd Annual Open Innovation Summit

August 11-13, 2010, Chicago, IL

The focus of the "2nd Annual Innovation Summit" was to discuss best practices and outcomes in open innovation within industry and government. Presentations were given by a diverse group of industry and government laboratories. Nona Cheeks presented on "NASA Goddard's Open Innovation Experiences." She also participated in a focus group discussion on the nexus of open innovation models in government and high tech and non-high tech industries. New business contacts and examples of open innovation resulted from the summit.

Licensing Executives Society USA/Canada Annual Meeting

September 26-29, 2010, Chicago, IL

Members of the NASA Goddard Innovative Partnerships Program Office attended the Licensing Executives Society (LES) USA/Canada Annual meeting. The meeting, themed "Deals, Deals and more Deals" focused upon how intellectual property (IP) is critical to managing new business strategies and ways to use IP to maximize opportunities for licensing deals. There were many workshops that delved into legal and business matters that could impact structuring the best and worst approach for seeking and perfecting licensing deals.

Industry Outreach

Next Steps in Managing Innovation Workshop

November 3, 2010, Uniondale, NY

NASA Goddard Space Flight Center's (GSFC's) Innovative Partnerships Program (IPP) Office held its semiannual Next Steps in Managing Innovation Workshop on November 3, 2010 at the Long Island Marriott Hotel and Conference Center in Uniondale, NY. The workshop focus was for NASA GSFC Small Business Innovation Research (SBIR) Program and the Small Business Technology Transfer (STTR) Program contractors along with other prime contractors to have the opportunity to learn about new technology access channels and how to leverage mutual opportunities of interest. 29 individuals from 23 SBIR companies, along with several prime contractors and three GSFC Assistant Chiefs of Technology (ACTs) discussed the advancement and use of the SBIR technologies.

Northeast Technology Exchange Conference

November 1, 2010, Windsor, CT

IPPO Sr. Technology Manager, Darryl Mitchell, shares GSFC emerging technologies with NeTEC attendees.

The Connecticut Center for Advanced Technology, Inc. presented the Northeast Technology Exchange Conference (NeTEC) 2010. NeTEC is the Northeast's primary conference focused on aerospace and defense technology transfer where emerging technologies with great commercial potential are showcased to entrepreneurs and investors interested in partnership opportunities. NASA Goddard Space Flight Center was among nearly 60 NeTEC 2010 exhibitors. The conference integrated presentations from University Technology Transfer Offices, OEM's and Federal Labs, which included a presentation by GSFC Innovative Partnerships Program Office's Sr. Technology Manager, Darryl Mitchell, who discussed GSFC technologies available for licensing as well as thrust areas of deep research and expertise.

IPP Office Chief Nona Cheeks (far right) networks with other attendees of the 2nd Annual Space Entrepreneurship Forum.

The 2nd Annual Space Entrepreneurship Forum

September 15, 2010, Washington, DC

The objective of the forum was to raise awareness of entrepreneurial opportunities and areas of growth for African-American-owned businesses interested in the space industry. Nona Cheeks, Chief of NASA Goddard's Innovation Partnerships Program Office participated in a panel discussion on the topic of "Opportunities in Government and Commercial Space Industry." Emphasis on NASA technology commercialization partnering practices and opportunities resulted in meetings with several conference attendees about NASA technology transfer, SBIR/STTR, and licensing opportunities.

ICAP Ocean Tomo IP Think Tank and Live Auction

March 24-25, 2010, San Francisco, CA

IPP staff participated in the spring 2010 ICAP Ocean Tomo conference, which included a live auction of several Goddard patent portfolio technologies. ICAP Ocean Tomo is a global intellectual property brokerage company that assists Goddard's IPP Office with transfer of NASA-developed technologies to the private sector for commercialization.

SBIR Pilot Program with Prime Contractors

March 2, 2010, Linthicum, MD

Darryl Mitchell, Goddard IPP Sr. Technology Manager, and representatives from several other NASA field center Small Business Innovation Research (SBIR) offices met with Northrop Grumman representatives to learn about a new SBIR pilot program being implemented among several prime contractors and the Department of Defense. The purpose of the meeting was to evaluate the potential for implementing a similar pilot program at NASA to improve the return on investment available from the SBIR efforts.

Public Outreach

The IPP Office maintains open lines of communication with the general public. The goal of these outreach efforts is to increase awareness of all the ways in which GSFC promotes America's scientific, economic and technological growth through public service.

IPP staff member Elizabeth Aleiner chats with astronaut John Grunsfeld at the NASA Day at Maryland Capitol event. Grunsfeld played a key role in repairing HST during the fourth servicing mission.

NASA Day at Maryland Capitol

February 23, 2010, Annapolis, MD

This annual event, sponsored by the Goddard Legislative Affairs Office, provides an excellent opportunity to help Maryland lawmakers, students, and other attendees gain a better understanding of Goddard's scientific achievements and positive economic impacts. Supporting the Hubble Space Telescope (HST) theme for the event, six members of the Goddard IPP team hosted a booth that highlighted HST technologies and spinoffs. Nona Cheeks, Goddard's IPP Chief, and IPP technology managers met with Maryland State Representatives to discuss ways to increase the visibility of Goddard's contributions to the state.

Public Service Recognition Week

May 6-8 2010, National Mall, Washington, D.C.

Celebrated since 1985, Public Service Recognition Week (PSRW) is a nationwide public education campaign honoring the men and women who serve our nation as federal, state, county, and local government employees and ensure that our government is the best in the world. From the steps of the Capitol to the smallest towns, public servants use the week to educate citizens about the work that they do and why they have chosen public service careers. Throughout the week, communities take this occasion to host events from open houses to parades recognizing and thanking their local unsung heroes. The capstone celebration is held every year on the National Mall, with more than 100 civilian and military agencies, nonprofit organizations, and private companies sponsoring interactive and educational exhibits that showcase the innovative and quality work performed by public employees.

Left: A child explores the NASA @ Home & City interactive application at Public Service Recognition Week.

Right: IPP staff member Dale Clark (right) and GSFC Public Affairs Officer Nina Harris at the IPP's display at Public Service Recognition Week.

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NP-2011-3-198-GSFC