National Aeronautics and Space Administration

Visualizing THE Future

[Accomplishments Report 2013]

Goddard Space Flight Center's Innovative Technology Partnerships Office

Visualizing THE Future

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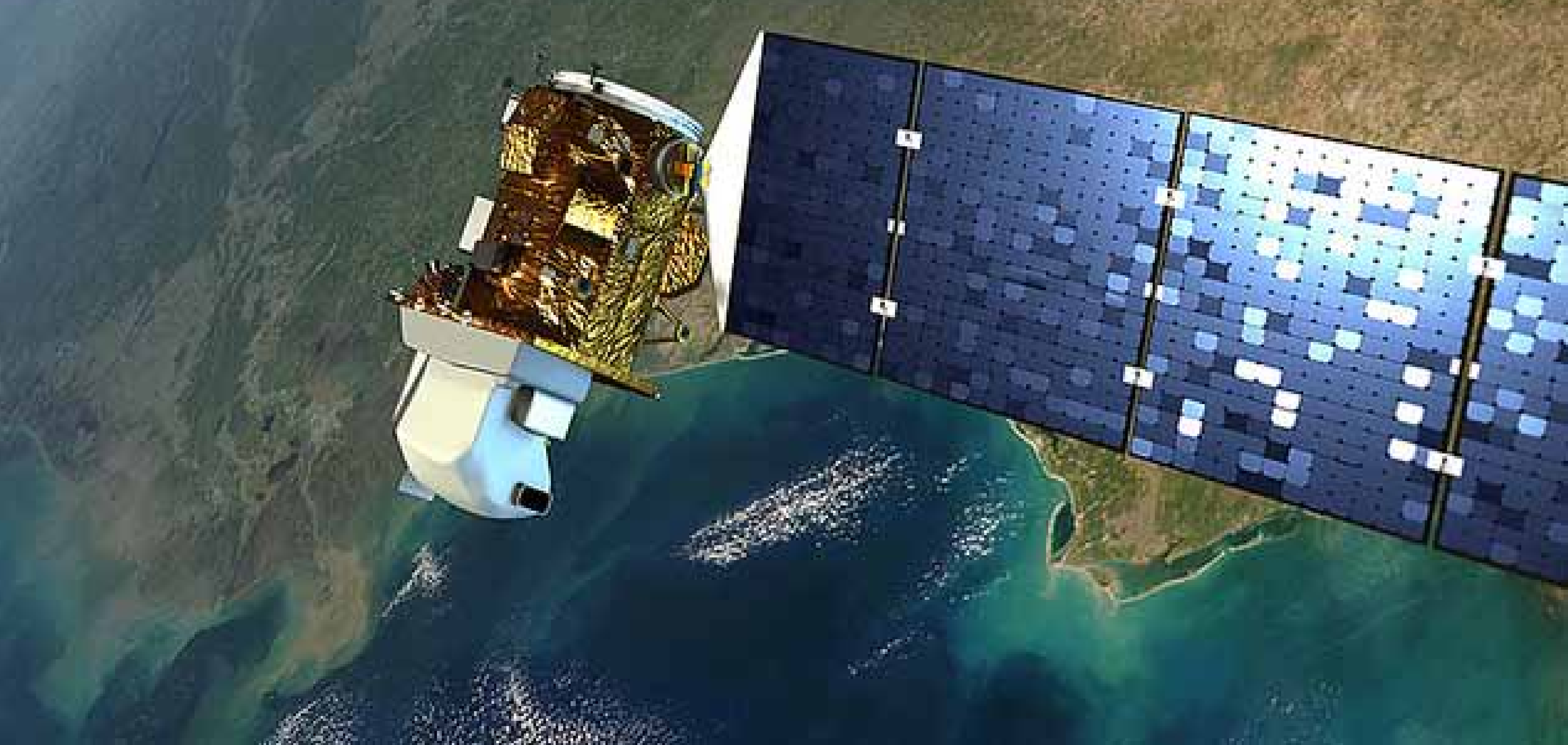
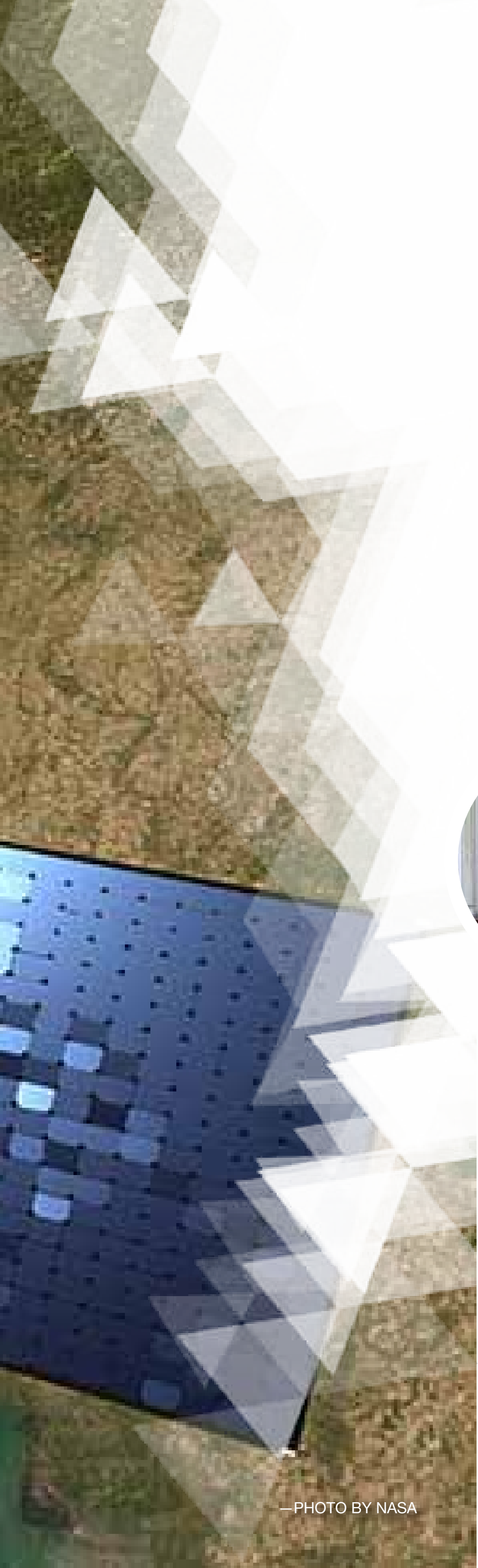




—PHOTO BY NASA

FROM THE CHIEF

Nona Minnifield Cheeks
CHIEF

Innovative Technology Patnerships Office
NASA Goddard Space Flight Center

It's been said that challenges are often opportunities in disguise. They motivate us to take action that not only addresses the immediate issue, but also provides long-term benefits that we may not otherwise have recognized. Thus, we are usually well-served by carefully examining and considering today's challenges and visualizing a future in which those challenges have provided us the opportunity to do novel and unprecedented things.

This is the theme of the 2013 NASA Goddard Innovative Technology Partnerships Office Annual Report. We review two excellent examples of how NASA Goddard has responded to present-day challenges, and in doing so created opportunities for new and exciting technologies. For example, it should come as news to no one that around the world, space science and exploration communities are being asked to do more with less. This challenge has sparked interest in CubeSat, a platform originally designed primarily for academic purposes. Although initially very limited in capability, the small size and relatively modest cost of a CubeSat makes it attractive in an environment where funding can be increasingly scarce. Over the past few years, there has been growing focus on enhancing the CubeSat platform, greatly expanding its functionality and ability to perform important science, an effort in which NASA Goddard has been at the forefront. In the process, a whole new industry has been created around these small satellites, one that offers the promise of a wide variety of business opportunities – simultaneously providing a relatively easy entry point into space for many entities that thus far have not been able to participate.

Another example of converting challenges into opportunities is the ongoing Landsat program, which in 2013 witnessed the successful launch and deployment of Landsat 8. In its 41 (and counting) years of service, Landsat has accumulated an unprecedented wealth of data about the surface of our planet. That data is now being utilized to understand and address one of the biggest and most high-profile challenges we face today: global warming. In addition, the freely available Landsat data is being adapted to applications in a broad spectrum of fields, from science, to humanitarian, and even commercial, in the form of data products offered to industries such as agriculture, forestry, investment, medical, and insurance.

In this report, we also review the activities of our own Innovative Technology Partnerships Office (ITPO). We present some of the events and initiatives we have undertaken during this past year and explain how they fit within the context of our overarching goal of visualizing a future in which present challenges have been converted into future opportunities. ITPO's role is to facilitate this process, always looking forward and taking innovative approaches to finding ways in which NASA Goddard technologies, developed in response to an immediate challenge, can provide far-reaching opportunities and benefits in 2014 and beyond.

2013 YEAR IN REVIEW

In this report we review some of NASA Goddard's major technology transfer related events and accomplishments in 2013. As with past reports for previous years, our focus is on NASA Goddard technologies, originally developed to support space missions, that can be adapted and applied for terrestrial use. These include:

- **CubeSat** is a standard for small satellites. Originally created as a way for students to gain hands-on experience with satellite development, CubeSat has matured and evolved into a platform with the potential to perform scientific and commercial space applications. NASA Goddard is developing new technologies that greatly extend the capabilities and reach of CubeSats. In addition to creating new business opportunities based on the CubeSat platform, these technologies may also be useful in terrestrial applications where limited size, modest power consumption, and ability to perform in harsh environments are important considerations.

- **Landsat Data Continuity Mission (LDCM)** is the latest mission in the Landsat satellite series. Landsat represents one of the most important and longest-running success stories in the history of NASA. Now in its fifth decade of operation, Landsat continues to provide invaluable data on Earth surface phenomena, and how it has changed over time. This data plays a critical role in understanding a number of the most pressing scientific issues of today. In addition, Landsat data — and the technologies developed during the long history of this program – are being leveraged by many industries, creating numerous global business opportunities.

In addition, we "re-introduce" the **Innovative Technology Partnerships Office (ITPO)**. This group, formerly known as the Innovative Partnerships Program Office (IPPO), is primarily responsible for facilitating the transfer of NASA Goddard technologies for use in other government centers, academia, and private enterprise. The ITPO also plays a leading role in bringing new technologies into NASA Goddard, through programs such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. We review the major activities of the ITPO in 2013, and hear the team's thoughts on their multiple roles within NASA Goddard.

This 2013 Accomplishments Report also looks back at technology transfer events and initiatives in which the ITPO participated. We also list patenting and technology reporting associated with NASA Goddard scientists and innovators.

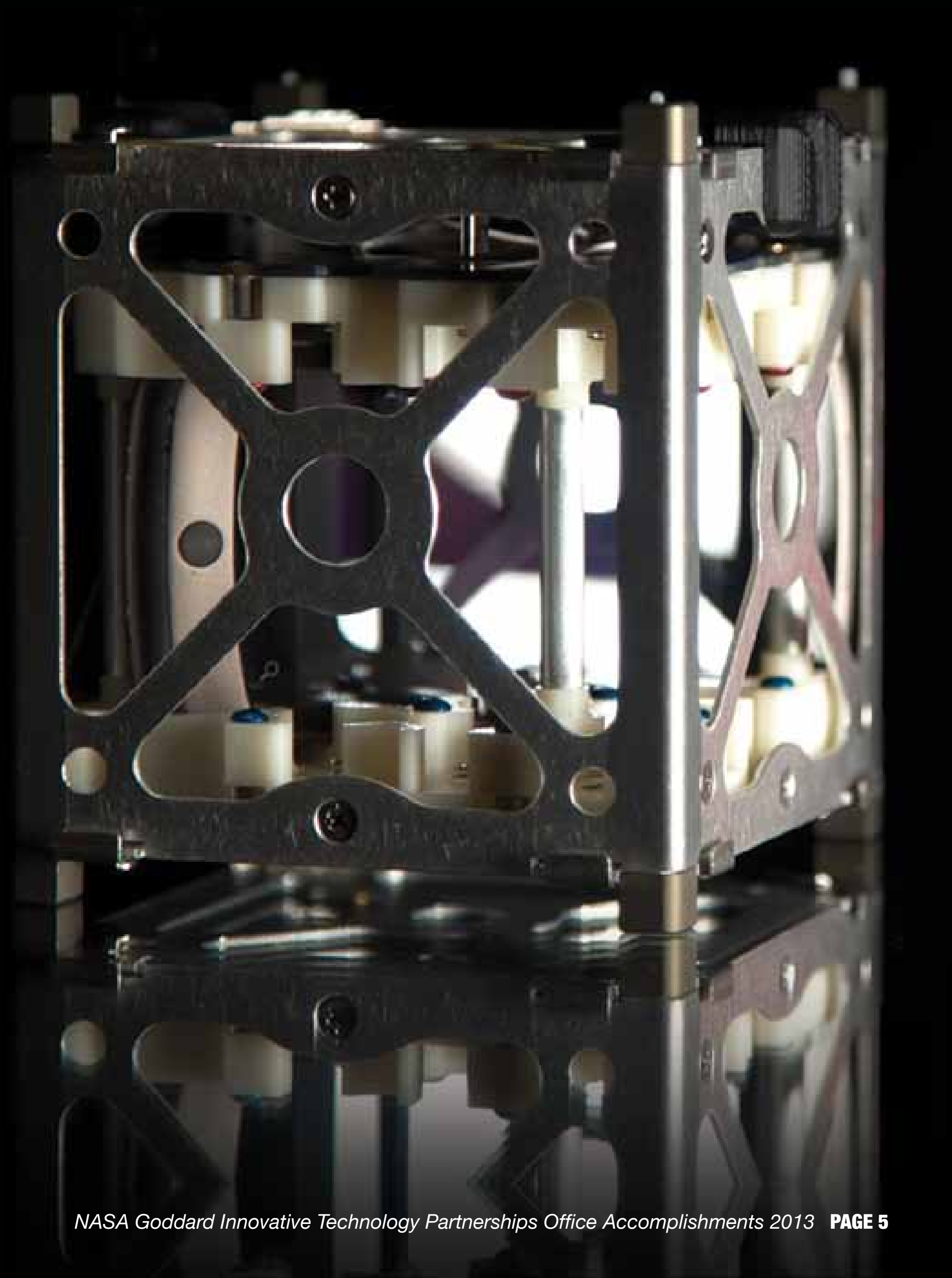
CUBESAT

The year 2013 could be considered the Year of CubeSat, with several important and newsworthy events attesting to the continued advancement of these small satellites. Originally conceived as a standard for student projects using off the shelf components, there has been increasing interest in CubeSat as a platform for performing important science and -- more recently – commercial applications.

The CubeSat standard was initially conceived in 1999, through collaboration between California Polytechnic State University and Stanford University. Initially, volume was confined to a 10 cm cube, with a mass not to exceed 1.33 kg. This is now referred to as a “1U” CubeSat; the specification has subsequently been amended to include larger devices.

Although early CubeSat development occurred primarily outside NASA Goddard; in recent years the Center has become more involved in CubeSats as former students have joined the staff, bringing their CubeSat knowledge with them. Today NASA Goddard and Wallops Flight Facility are heavily involved in the advancing evolution of CubeSat, with Wallops serving as a primary collaborator with the National Science Foundation’s CubeSat activities.

In this section we review some of the important CubeSat events and developments that occurred during the past year at NASA Goddard’s Wallops Flight Facility. We also take a quick look at some of the developing commercial aspects of CubeSat, including potential future applications and markets for these small satellites.



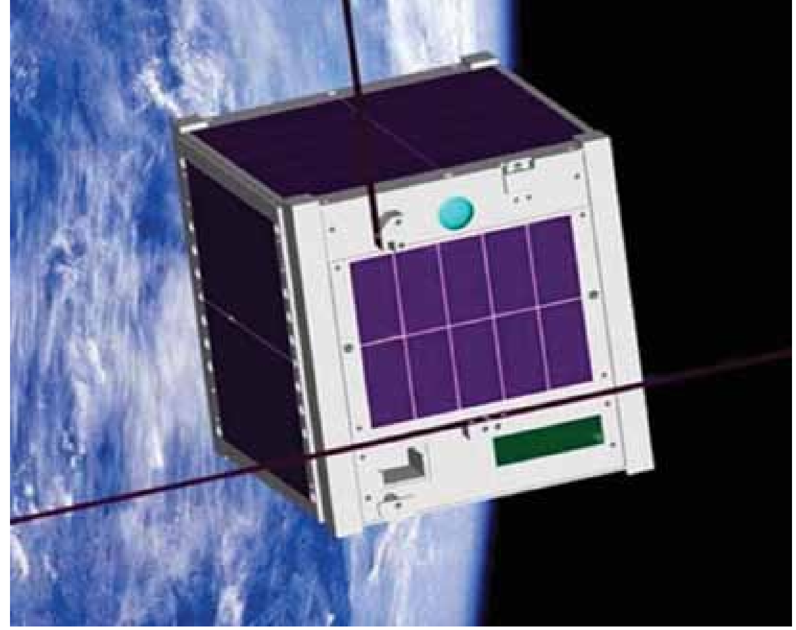
CubeSat and the Commercial Market

As originally conceived, the CubeSat platform was intended as a teaching tool to provide students with hands-on experience with basic satellite concepts. Its commercial potential was not initially a primary concern. Since that time, several trends have helped drive renewed focus towards developing CubeSats for more robust and demanding applications. In these years of budgetary constraints, science and industry are being asked to do more with less. In this regard, CubeSats can be especially attractive given their relatively modest cost. Increasing miniaturization of electronic components now provide the ability to expand CubeSat capabilities while retaining a small overall size. And advances in computing power and functionality offer the promise of multiple CubeSats working in concert, performing the tasks of a large mission at a fraction of the expense.

As a result of these and other factors, CubeSat as a platform is now receiving serious attention from the commercial sector. For example, there is already a niche market for CubeSat components. NASA Goddard's TechCube initiative may eventually create a demand for high-performance high-reliability CubeSat parts. Wallops Flight Facility provides support services that are critical to U.S. based CubeSat projects. Several NASA Goddard technologies associated with CubeSats, such as SpaceCube Mini, offer potential in numerous aerospace applications. CubeSat satellites could perform a number of business applications such as satellite servicing and remote sensing. And CubeSats provide a low entry point for vendors to do business with NASA Goddard.

CubeSat components as an industry

One of the first commercial markets associated with CubeSat involves the production of components suitable for CubeSat missions. In recent years the number of CubeSat missions and applications has expanded significantly. This has in turn created a small but growing niche market for CubeSat-compliant components. For instance, CubeSat.org web site lists a number of vendors who sell CubeSat



Artist rendition of a CubeSat satellite in orbit. —PHOTO BY NASA

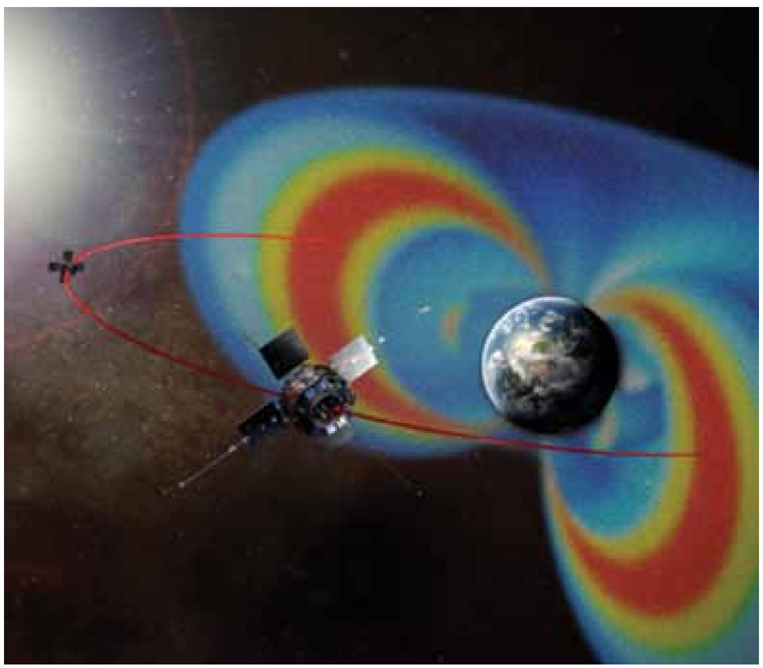
parts (see http://www.cubesat.org/index.php/collaborate/suppliers). Although this market has yet to achieve the multi-billion dollar level required to interest large suppliers of electronics, it has evolved to the point where smaller players find it attractive. "CubeSats are ideal for smaller companies" states Thomas Flatley (Branch Head, Science Data Processing Branch). "…[T]here are niche markets that could appeal to small and medium size companies."

One important consumer of CubeSat components is NASA Goddard itself. NASA Goddard innovators continue to push the boundaries of CubeSat capability into deep space and "beyond LEO" Earth orbits. In doing so, they have created a corresponding need for highly reliable CubeSat components. Building a CubeSat project quickly requires reliable electronic components. Suppliers of these electronics can find CubeSat to be a relatively easy entry point for doing business with NASA Goddard. In return, CubeSat provides an excellent way for new technology and capabilities to come into NASA Goddard.

For example, NASA Goddard is developing TechCube, an initiative designed to extend CubeSat projects for use in deep space and for long-duration and "beyond LEO" Earth orbits. To do this, TechCube satellites are made from highly reliable components from select vendors/universities, other government agencies (NRL, AFRL), and high-reliability components developed internally at NASA Goddard. The success of TechCube could in turn create a new market for the suppliers of TechCube components. The Department of Defense has an interest in TechCube, as do other agencies that have a need for highly reliable CubeSat projects.

The development of highly reliable CubeSat technologies is already sparking the creation of new startup businesses. For instance, several major universities are actively developing high-performing CubeSat components. A number of professors involved in this research have created spinoff companies specifically dedicated to doing CubeSat business.

CubeSats provide a platform to test "space readiness"



NASA Goddard's Compact Relativistic Electron and Proton Telescope (CREPT), a CubeSat mission, will explore Earth's Van Allen belts. —PHOTO BY NASA

CubeSats provide relatively "low-impact" access to space. This allows for low-cost testing and validation of components and systems within the harsh environments of space. Inventors can design a CubeSat mission for demonstrating proof-of-concept for all kinds of systems and instruments, and then observe how the technology performs. In this way, a CubeSat can serve as a "laboratory in space," helping to validate a technology. A number of CubeSat projects have been designed for this purpose, testing technology both for NASA and the private sector.

By providing quick access to the space environment, NASA Goddard can help the CubeSat platform become more reliable. In its early days as a largely academic tool, the CubeSat platform often proved unreliable, with up to half the missions failing. Improving on this record requires more reliable components for CubeSats; however the development of these new technologies can be a challenge for universities. In addition to providing a space platform for testing these new components, NASA Goddard also has the resources and expertise to help develop these new technologies in-house. Areas in which the Center can provide special value include electronics miniaturization and environmental testing. NASA Goddard has large and diverse technology development resources devoted to these areas.

Potential CubeSat commercial applications

As new components and technologies continue to make CubeSats more robust, these small satellites can eventually be adapted to numerous commercial applications. These could include satellite servicing, vehicle examination, space station inspection, and removal of space debris. The last is an interesting possibility – a CubeSat device could be designed to track and attach itself to an unwanted satellite that has fulfilled its useful life, and propel the satellite back into the atmosphere to be destroyed.

Other possible commercial applications for CubeSat missions include remote sensing and surveillance, such as launching CubeSats from an aircraft to observe a region of interest. CubeSats may also be useful for applications including defense, search and rescue, and disaster management.

NASA Goddard enhances CubeSat capabilities

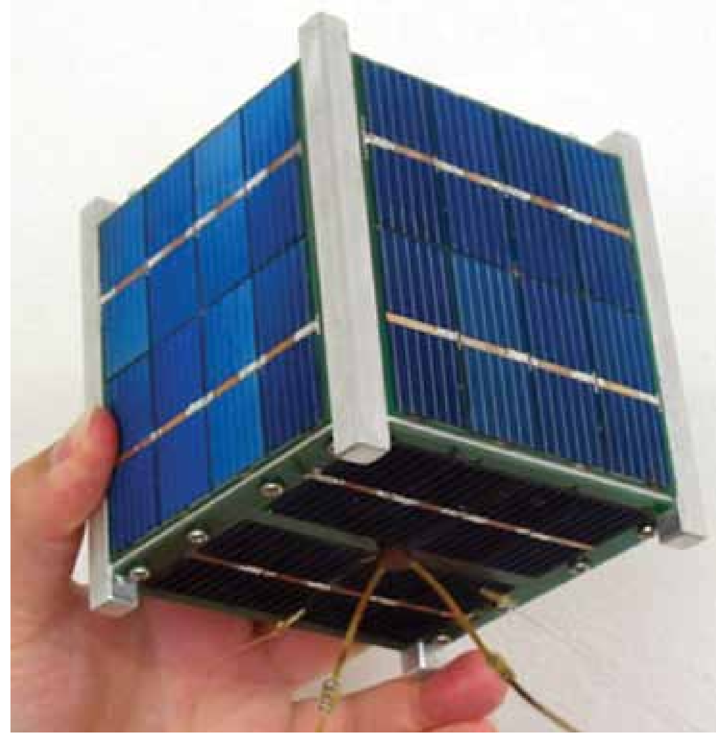
NASA Goddard's ongoing CubeSat work also opens up potential future applications far beyond the platform's current capabilities. For example, CubeSats could be developed into flying constellations of satellites, to measure particles and plasma fields. Some of the ideas being considered include sending swarms of CubeSats into space, all communicating with each other. CubeSats could be part of a hybrid mission involving a large "mothership" satellite and a number of smaller CubeSats. The smaller satellites can be controlled by the main satellite to perform tasks that may be difficult or risky.

One potentially important NASA Goddard technology in development is SpaceCube Mini, a miniaturized version of the SpaceCube 2.0 high-performance data processor small enough to be used on CubeSat projects. SpaceCube is designed to increase the data processing power of a CubeSat mission by one or two orders of magnitude. This technology may also offer value in terrestrial applications. SpaceCube could be useful for other high-data systems, providing both data reduction and onboard awareness. SpaceCube allows for autonomous operations, which could be valuable in applications where instruments collaborate with each other, such as a sensor web.

Other technologies in development address the "3 Ps" – propulsion, positioning, and power – whose availability would significantly strengthen CubeSat as a robust, versatile platform. For example, Wallops Flight Facility has the capability to launch sounding rockets from many different locations. It may be possible to marry this capability to CubeSat launches. Although sounding rockets are currently limited to sub-orbital flight, they may eventually evolve to the point where they can launch CubeSats into orbit. This would remove the need for CubeSats to "hitch hike" on launches primarily dedicated to larger missions.

Developments that could significantly improve the utility of CubeSats include:

- **CubeSat Power System with Automatic High-Powered Payload Cycling (GSC-16679-1)**. CubeSats traditionally are very low power systems that have difficulty with high-powered payloads. This new CubeSat power system will automatically turn a high-powered payload on/off based on the battery state-of-charge. This will enable a new class of CubeSat payloads and allow for more advanced research to be conducted from a CubeSat satellite.



A 10cm by 10cm by 10cm CubeSat. —PHOTO BY NASA

- **Micro-Resistojet for Small Satellites and Various Propellants Especially Methanol (GSC-15053-1)** provides CubeSat with a novel micro-resistojet for use with various propellants. The micro-resistojet is especially suited for "green" methanol.

- **SmallSat Constraint and Deployment System (GSC-16305-1)** offers a more secure constraint interface during CubeSat launch and an efficient guided ejection, while permitting a less restrictive inner volume.

In addition, Maryland Aerospace is working with NASA GSFC to develop a CubeSat pointing system, partially funded through the NASA SBIR program. These and other technologies will not only help make CubeSat projects more commercially promising, they may also offer the potential to be adapted for other terrestrial markets.

A Busy Year for CubeSat at NASA Goddard

NASA Goddard Space Flight Center remains an important leader in evolving CubeSat technology from its original purpose as an academic tool to a robust platform to perform important scientific observations and commercial applications. NASA Goddard innovators are helping to extend CubeSats into deep space by actively seeking ways to make these small satellites more robust and versatile. The year 2013 witnessed several critical developments and events that may prove to be milestones in the ongoing maturation of CubeSats.

CubeSats and Wallops Flight Facility

A central "hub" of CubeSat related activity is Wallops Flight Facility. In 2008, National Science Foundation (NSF) selected Wallops Flight Facility to collaborate with their CubeSat activities. Since then, this collaboration has provided invaluable tools and services to the CubseSat community.

For example, Wallops Flight Facility has made its engineering staff available to mentor CubeSat developers. The Facility also offers use of its lab test facilities for applications such as vibration testing, antenna analysis, and GPS simulation. Wallops also provides a 60-foot dish antenna for ground station support.

According to Scott Schaire (Small Satellite and Orbital Payloads Projects Manager for Wallops Flight Facility, Suborbital and Special Orbital Projects), "CubeSats provide a method for placing instruments in orbit quicker than with conventional satellites… The value-added support that we provide to the CubeSat community is an extension of the support we provide to the suborbital community." And as Ben Cervantes (Mission Planning Lab Lead, Wallops Flight Facility) points out, "Wallops has a lot of experience in suborbital flight, usually involving satellites or other UAVs [unmanned aerial vehicles]. CubeSats fit nicely into this niche, and aligns very well with what Wallops does,

A CubeSat in development —PHOTO BY NASA

which primarily involves low-cost missions. We're developing technologies to be more and more miniaturized, to fly on UAV missions. When a technology is sufficiently miniaturized, it can fly on a CubeSat to gather science data."

CubeSat events in 2013

This past year was an extremely busy one for CubeSat related activities, For example, on February 26, 2013, NASA announced the fourth round of CubeSat Launch Initiative (CSLI) selections. A total of 24 CubeSats will be launched as secondary payloads onboard missions planned for 2014 through 2016. These selections are part of NASA's ongoing CubeSat Launch Initiative program that provides opportunities for CubeSats to fly on rockets planned for upcoming launches.

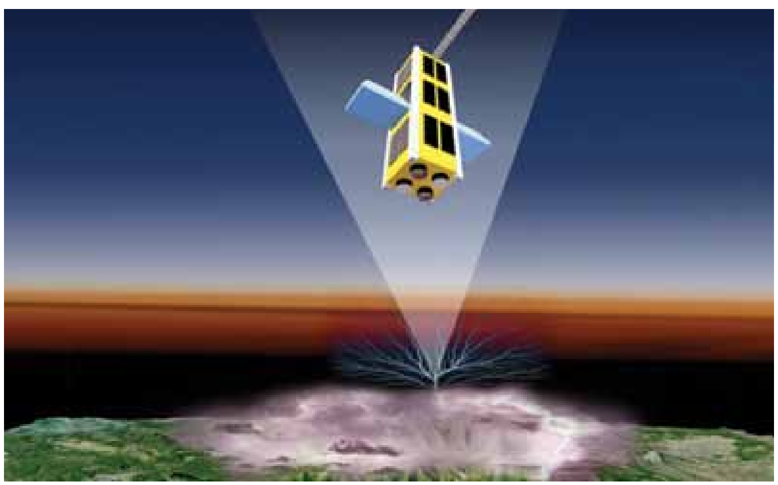
Among the successful proposals are projects from universities, non-profit organizations, NASA Centers, and a Florida high school. Three of these CubeSat missions are being developed at NASA Goddard Space Flight Center. For a complete listing of the successful CSLI mission selection, see *http://www.nasa.gov/directorates/heo/home/CSLI_selections.html.*

Another milestone event occurred when the Antares launch from Wallops Flight Facility made its maiden flight on April 21, 2013. Antares' primary payload was the Cygnus Mass Simulator, an inert vehicle designed to simulate the mass of a Cygnus spacecraft.

In addition, Antares also carried four CubeSats into orbit. Three of these were NASA-built PhoneSats: "Alexander," "Graham," and "Bell." Graham and Bell are PhoneSat 1.0 devices, while Alexander is a PhoneSat 2.0b.

PhoneSats are technology demonstration 1U CubeSats designed to test the feasibility of building satellite onboard systems around off-the-shelf mobile telephone technology. These satellites are among the least expensive ever constructed, with a budget of $3,500 per PhoneSat 1.0 unit and $8,000 for PhoneSat-2.0s.

Later in the year, on November 19, 2013, 11 CubeSat satellites were launched into space from NASA Goddard's Wallops Flight



Artist's Conception of Firefly. —PHOTO BY NASA

Facility. This launch was part of the ongoing CubeSat Launch Initiative program. These CubeSat satellites were carried as auxiliary payloads aboard a U.S. Air Force Minotaur 1 rocket. The miniature satellites, which included the first developed by high school students, all appear to have commenced successful operation after deployment.

Among the more high-profile of these CubeSats is the National Science Foundation Firefly mission. Firefly will explore the relationship between lightning and so-called Terrestrial Gamma Ray Flashes (TGFs), a phenomenon first discovered in the 1990s.

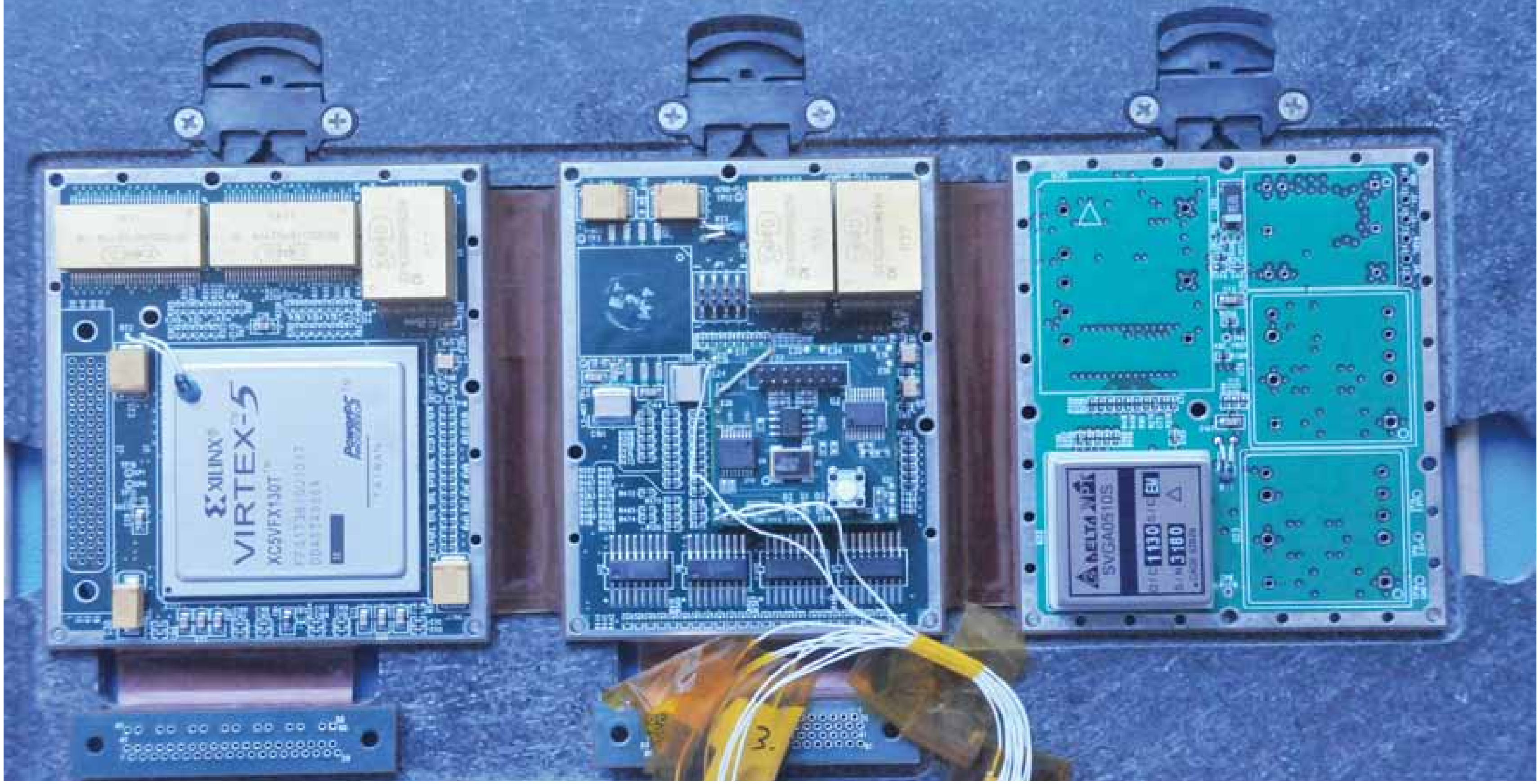
Firefly will investigate which types of lightning produce TGFs, to help scientists better understand the cumulative effect that terrestrial lightning has on the upper atmosphere and near-Earth space environment.

Future CubeSat developments and events

One upcoming NASA Goddard mission that utilizes the CubeSat platform is the Compact Radiation Belt Explorer (CeREs). This is a 3U CubeSat that will be placed in a high inclination LEO. CeREs will study primary radiation belt energization, as well as loss electron spectra and microbursts. It will also observe solar electron spectra from > 5 keV.

Beyond individual missions, NASA Goddard continues to lead the effort in enhancing CubeSat capabilities. For instance, CubeSat has historically lacked sufficient robustness and reliability to extend beyond LEO applications. To address this, NASA Goddard is developing a scalable, high reliability bus known as TechCube. According to Thomas Flatley (Branch Head, Science Data Processing Branch), "TechCube's avionics subsystems will be made using highly reliable parts and our 'flight' design processes, like our regular satellites. We're working with universities, other government agencies and private companies to identify who is (or can be) providing quality components that can be used on TechCube. The goal is to take a combination of the best existing DoD/commercial

Antares launches at Wallops Flight Facility, with four CubeSat satellites onboard.
—PHOTO BY NASA



SpaceCube Mini. —PHOTO BY NASA

components, plus new components that we design at NASA Goddard, and use them to build the hi-rel TechCube bus. Both deep space projects and long duration Earth orbiting missions (LEO, polar, MEO, GTO/GEO) would require TechCube."

Another NASA Goddard effort is SpaceCube Mini, a miniaturized version of the SpaceCube 2.0 high-performance data processor. With this technology, a CubeSat mission could theoretically process raw data in real-time and only store processed data or extracted information, yielding significant savings in on-board storage and downlink bandwidth, and enabling 24/7 operations.

Another CubeSat limitation being actively addressed is propulsion. Currently, CubeSats are placed into space solely as secondary "piggyback" payloads for primary missions. Full exploitation of this platform may require a dedicated means for CubeSat propulsion. In addition to rocketry, other platforms are being examined. For instance, a program called High Altitude Student Payload (HASP) involves teams of students developing balloon-borne projects. So far Wallops has launched a number of payloads using a gondola structure, including several instruments over Antarctica. These devices were in the air for 50 days, reaching altitudes of 115,000 to 130,000 feet -- above 99.9% of the Earth's atmosphere.

Other potential propulsion methods include launching CubeSat devices from an airplane platform, or even via a cannon-type device to shoot CubeSats into orbit. Wallops currently holds a record for the longest cannon-based launch of a particular diameter projectile without any propulsion on the projectile. The Facility is now investigating hosting a railgun that uses electromagnetic force to propel the payload. Although it's probably unlikely that this device will be used to launch CubeSats into Earth orbit; it could eventually be developed for use on the moon to launch payloads from the lunar surface into deep space.

ITPO

INNOVATIVE TECHNOLOGY PARTNERSHIPS OFFICE

The NASA Goddard Innovative Technology Partnerships Office (ITPO) facilitates technology transfer in NASA Goddard. Among their primary goals are to make technologies developed at NASA Goddard available to other entities (including other government agencies, academia, and the private sector), bringing new technologies and capabilities into NASA Goddard through programs such as the SBIR/STTR programs, and public recognition and outreach.

In many respects, the ITPO represents the embodiment of this 2013 Accomplishment Report's central theme of "visualizing the future." The central function of the ITPO is to inventory and assess the portfolio of new technologies being developed at NASA Goddard, and then visualize all the ways each of these technologies can be leveraged into new future applications, often far removed from its original purpose. This requires broad technical understanding and insight into commercial markets. Finding the right niche and right partner for a technology takes imagination and vision – and can be exceptionally rewarding, as when for example a technology developed for processing satellite images is adapted to a new medical image technology that offers significant potential to save lives.

In this section, we review a few of the many ongoing functions and initiatives the ITPO is involved in to promote innovation and technology transfer through NASA Goddard. This includes a variety of "non-traditional" approaches to raising awareness of NASA Goddard technologies and capabilities. We summarize some of the ways the ITPO has significantly broadened its reach in recent years, gaining access to communities that historically have been inaccessible or overlooked in terms of technology transfer.

We also look back on some of the noteworthy events and milestones for the ITPO during the past twelve months. This includes meeting with education and business leaders, outreach events such as the OPTIMUS PRIME Spinoff Awards, and others. And we hear from members of the ITPO team itself, who offer a few insights about the ITPO's activities, their challenges and successes, and the ITPO's evolving role in the ever-changing world of technology transfer.

Innovative Technology Partnerships Office

One noteworthy 2013 event for the team responsible for facilitating technology transfer within NASA Goddard was a change of name. Formerly known as the Innovative Partnership Programs Office (IPPO), the group is now known as the Innovative Technology Partnerships Office (ITPO). This name is in keeping with the group's focus on technology: transferring technologies developed at NASA Goddard and making it available to other entities for other applications; while simultaneously working to bring new technologies into NASA Goddard to serve space missions, through vehicles such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

New Technology Assessment

To properly assess the full scope of available NASA Goddard technologies, the ITPO helps innovators ensure their inventions are reported via the New Technology Assessment (NTA) system.

The ITPO regularly meets with scientists and engineers to stay ahead of the latest research and development throughout the Center. This is one of the first steps to insure that all publicly funded technology created within NASA Goddard is properly assessed and made available for technology transfer as appropriate.

The ITPO also facilitates the process of protecting NASA Goddard's intellectual property (IP). For example, the ITPO works in conjunction with the NASA Goddard Office of Patent Counsel to help determine which technologies are good candidates for patenting. The group also offers advice and guidance to inventors interested in pursuing patents for their innovations. This can be an especially confusing process to those unfamiliar with the recent changes in U.S. patenting law and procedures.

Of course, a thorough inventory of new technologies is only the first part of the process. The ITPO must analyze the potential of these technologies, and whether or not they could be adapted to applications outside NASA.

This can often be a challenging process. In many cases, a technology has been created for a very specific purpose for a particular space science mission. The function of the technology may at first appear to be so narrowly defined that any potential terrestrial uses for it may not be obvious. The ITPO works with inventors to understand all facets and capabilities of the technology. They then consider all possible ways the technology could be leveraged into new and often very different types of applications.

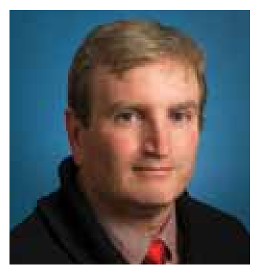
Partnerships

The ITPO staff comprises a diverse group of engineers and scientists committed to looking at new ways for facilitating technology transfer. This includes forming partnerships – the "P" in "ITPO" – with a wide spectrum

Ted Mecum

Senior Technology Manager

"We are here to help NASA Goddard protect its strategic assets. The first step in that is to identify those assets. In many cases, inventors may not even realize the potential impact their technology may have outside of the Center."



Darryl Mitchell

Senior Technology Manager

"The America Invents Act has significantly changed the playing field. In order to avoid disclosing the details of an invention before the IP protection is securely in place, we now tend to be more targeted in our approach to promoting technologies."

of key contacts who can provide access to many different markets and communities throughout government, academia, and industry.

The ITPO frequently collaborates with organizations and agencies that serve often under-represented segments of the business community. A small business can be an ideal commercialization partner for a NASA Goddard technology, particularly those best suited for specialized niche markets and applications that may comprise too small a revenue opportunity for larger companies to pursue. To reach small companies, the ITPO works with organizations dedicated to the promotion and development of small technology businesses in a particular state or region.

In addition to gaining access to outside networks, partnering also offers the ITPO multiple perspectives by which to assess a technology's potential. These perspectives often lead to "outside the box" ideas, as different groups and individuals often know of requirements and needs that a NASA Goddard technology can address. These can include applications far removed from the original purpose for which these technologies were invented.

In pursuing technology transfer opportunities, the ITPO has initiated a number of innovative approaches to move technologies developed at NASA Goddard into private industry. This includes IP auctions, publishing online catalogs of technologies, and hosting and sponsoring tech briefings to industry clusters in which the ITPO team presents specific segments of the NASA Goddard technology portfolio.

Bringing new technology into NASA Goddard

In addition to helping to make NASA Goddard developed technologies available for non-NASA agencies to leverage into new and novel applications, the ITPO also helps NASA Goddard acquire new technologies from the outside. In many cases, it is more efficient and timely to bring in a technology from outside NASA rather than develop it in-house. The ITPO is active in this process; helping define technology gaps within NASA Goddard and identifying potential outside collaborators that can help bridge these gaps with existing technologies or new ones developed specifically for NASA's needs.

One way to do this is via the previously mentioned Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. The SBIR program is a U.S. Federal Government-sponsored initiative that provides funding for small businesses to help develop their inventions into commercial products and services. The four primary goals are to (1) stimulate technological innovation, (2) meet U.S. government research and development needs, (3) promote participation in innovation and entrepreneurship within historically disadvantaged communities, and (4) increase commercialization of innovations derived from governmental R&D funding.

The STTR program is similar to the SBIR program, with the primary difference that it involves funding of small businesses working in collaboration with nonprofit research institutions. The goal of STTR is to move ideas from the laboratory into the commercial marketplace.

Jim La

Technology Manager

"One mistake innovators often make is to believe their technology has only one unique purpose, and may not be suitable for anything other than the space application for which it was originally developed. The ITPO philosophy is just the opposite: the possibilities are endless."

Dennis Small

Technology Manager

"We use NASA Goddard technology to build partnerships with industry, government agencies, and universities. Our office works to license NASA Goddard developed technologies that have commercial application that leads to stimulating …the economy world-wide."

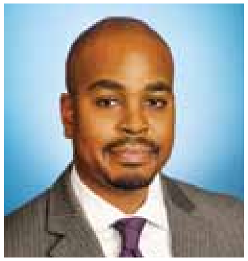
NASA maintains an active SBIR/STTR program that operates across NASA Centers. A feature of NASA's program is the fact that these awards take the form of a contract between NASA and the small business. When the work contract is completed, NASA's partner retains the rights to the IP developed through the contract.

Conclusion

This article has touched on just a few examples of the many initiatives and programs the ITPO is engaged in to promote and facilitate technology transfer throughout NASA Goddard. In addition, there are many other methods and venues also being considered and developed.

It is important to bear in mind that innovation and technology transfer go hand-in-hand. As new inventions are developed within NASA Goddard, the need to make these inventions available to outside entities grows. But in a critical way, technology transfer ultimately leads to future innovation. As space technologies find their way into the private sector, and the layperson recognizes and understands the practical value of these technologies, the public is further motivated to support future space research.

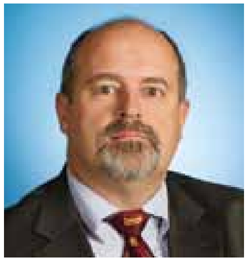
By helping ensure that NASA Goddard fulfills its U.S. Government mandate to make all its technologies available for non-NASA use, the ITPO raises awareness of these technologies outside NASA. This plays an essential role in helping ensure that NASA Goddard continues to fulfil its unique role in the exploration of Earth, the Solar System, and the universe.



Ramsey Smith

SBIR/STTR Deputy Program Manager

NASA's SBIR/STTR program has the unique mission to enable Small Businesses to develop technologies that address our technology needs, expand the technical expertise of our SBIR firm, provide an infrastructure for future partnerships between NASA and Small Technology firms and foster grow in the STEM sector of the American economy. The SBIR/STTR program is an invaluable resource to both the NASA technology community and our nation's small business community that will continue to benefit the NASA for years to come.



Steven Naus

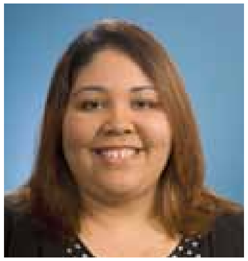
SBIR/STTR Program Manager

"The SBIR program has changed over the years. At first, we'd look at single patents. This year [2013], we basically look at the whole technology portfolio and make it available for consideration."

Nona Cheeks

ITPO Chief

"It's important to understand that technology transfer is a two-way street. Not only does it involve applying a NASA-developed technology to an industry need; it also entails filling a NASA need by forming relationships with outside entities."



Enidia Santiago-Arce

Technology Manager

"The ITPO is here to help. We don't just go around collecting NTRs [New Technology Reports]; our ultimate goal is to empower the use of NASA Goddard technology beyond the original space applications for which it was developed."

LDCM

LDCM/LANDSAT 8

Few NASA Goddard missions have achieved the high level of public visibility as the Landsat program, which in 2013 celebrated its 41st anniversary of ongoing operation. Beginning with the launch of Landsat 1 in 1972, the program represents the longest continuously running record of changes on the surface of our planet as observed from a space-based platform.

In 2013, the Landsat Data Continuity Mission (LDCM), later renamed Landsat 8, took flight as the latest and most advanced instrument in the Landsat program. Along with its predecessor, the still-operational Landsat 7, these instruments observe every spot on Earth an average of once every eight days.

Onboard LDCM/Landsat 8 are two primary instruments, both developed at NASA Goddard: the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). Together they continue the long tradition of providing Earth science imagery for numerous terrestrial uses; including energy and water management, forest monitoring, human and environmental health, urban planning, disaster recovery, agriculture, and many others.

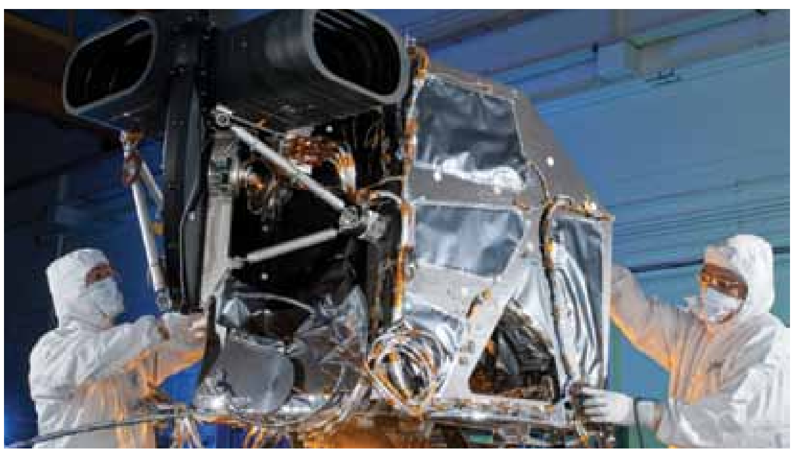
In this section we look back on some of the past year's major developments and events related to LDCM/Landsat 8. We also briefly review a few examples of the Landsat program's value to commercial interests. This includes applications based on the data provided by Landsat. We also examine how technologies developed for LDCM and its predecessors have also provided value to users back here on Earth, often in ways the original inventors may not have anticipated.

LDCM Technologies and Commercial Applications

The Landsat program's ongoing contributions to science are many and obvious. Perhaps not as well-known is the commercial value Landsat provides to a number of different industrial sectors. Landsat data is currently being used in a wide variety of ongoing applications, including for-profit services. Technologies originally developed and/or adapted for Landsat missions have been leveraged for uses outside the program. In addition, the Landsat program itself helped establish the multi-billion dollar industry built around observing Earth from space.

LDCM/Landsat 8: New Technologies and Capabilities

As we noted in a separate article in this report, LDCM/Landsat 8 primary instruments are the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), both of which were developed at NASA Goddard. The OLI observes Earth in visible light, near infrared, and shortwave infrared. The images captured by the OLI offer spatial resolutions of 15 meters



LDCM Operational Land Imager (OLI) **—PHOTO BY NASA**

(panchromatic) and 30 meters (multi-spectral) along a 185 km wide swath of the Earth's surface. This allows researchers to clearly distinguish features such as urban centers, farms, forests, and other topographies.

The OLI instrument represents a significant enhancement over previous Landsat missions. It takes advantage of a technological approach pioneered by NASA's experimental EO-1 satellite. To provide better land surface data while simultaneously reducing the moving parts required for the hardware, OLI incorporates a "push-broom" design that uses long detector arrays, with over 7,000 detectors per spectral band, aligned across its focal plane to view across the swath. This will deliver more reliable data with higher signal-to-noise ratio.

The second primary LDCM/Landsat 8 is the TIRS. This instrument measures land surface temperature in two thermal bands, incorporating a novel technology known as quantum well infrared photodetectors (QWIP) that employs complex quantum mechanics physics to detect heat. QWIP arrays offer a new, lower-cost alternative to conventional infrared technology.

TIRS uses QWIP detectors to record thermal infrared radiation emitted by the Earth whose intensity depends on surface temperature. These wavelengths, called thermal infrared, are well beyond the range of human vision. The QWIP detectors that TIRS uses are sensitive to two thermal infrared wavelength bands, allowing the instrument to separate the temperature of the Earth's surface from that of the atmosphere. In addition to these infrared detectors, other key instrument components within TIRS include the telescope optics, cryo-coolers, mechanical subsystems and electrical systems.

TIRS is especially valuable to water resource managers who rely on its highly accurate measurements to track how land and water are being used. For example, in the western U.S. states, where nearly 80% of available fresh water is used to irrigate crops, TIRS provides an invaluable tool for managing water consumption.

Similar to OLI, TIRS also incorporates a "push-broom" approach that provides a 185 km field of view, with a spatial resolution of 100 meters. This is sufficient for critical applications such as measuring water consumption over fields that use center-pivot irrigation.

Assembling the TIRS instrument.
—PHOTO BY NASA

Applications for LANDSAT data

Landsat data is archived in a USGS facility in Sioux Falls, South Dakota. This archive is then made available to anyone who has an application for it. These include a broad and diverse variety of science and resource applications relating to changes on the Earth's surface. Examples include forest monitoring, urban development and growth, and changes to glaciers and polar sea ice. The data is also used to monitor acreage for agricultural production. Another application is water management. These and other surface features can be monitored in real-time.

Although Landsat data isn't specifically designed for disaster monitoring and response; it can play a critical role in disaster aid and recovery. Landsat data has been used to compile severity maps in burn areas. These maps help guide emergency recovery teams to mitigate damage and stabilize slopes. Anywhere a major disaster occurs, the Landsat archive can provide "before and after" data that allows for impact assessment.

This data is used internationally. Currently, Landsat data is directly downloaded to approximately a number of ground stations located outside the U.S.

Landsat 7 image of a forest fire in Arizona. Purple represents heavily burned areas.
—PHOTO BY NASA

In the commercial sector, one potential use of Landsat data involves timber resource management. The wood and paper industries have expressed interest in supporting future Landsat missions. The USDA Foreign Agriculture Services uses Landsat data to develop its global commodities forecast, which is used by investors. The forecast is available via subscription; a copy is sent directly to the Commodities Exchange in Chicago.

Landsat also provides imagery used by Google Earth. Large-scale Google Earth images are based on Landsat data. Users viewing an image covering 50 to several hundred miles across in Google Earth are likely looking at data provided by Landsat.

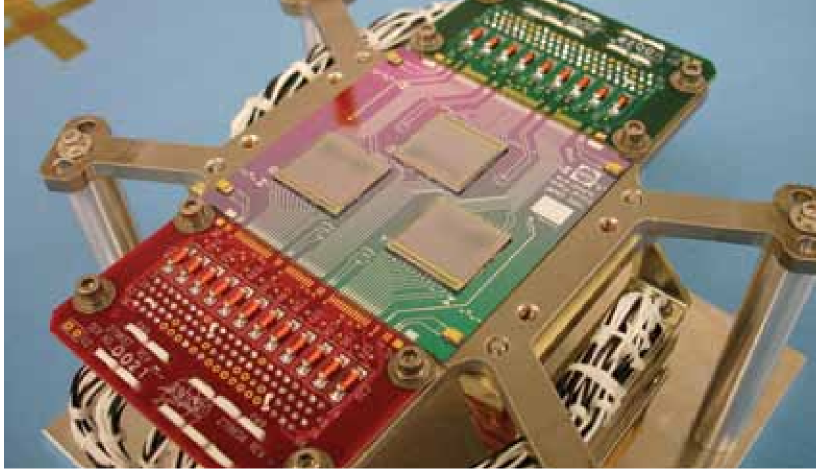
In addition, the U.S. Geological Survey's Earthshots web site (*http://earthshots.usgs.gov/earthshots/*) provides public access to Landsat imagery data. Earthshots allows users to explore how the surface of our planet has transformed over the 41 years the Landsat program has been in operation. This data has been used for forest management and deforestation tracking, fire science (including wildfire control planning), agricultural planning (including water resources, forecast crop success, and invasive species monitoring), and city planning among others.

Landsat Establishes a New Industry

One major contribution provided by the Landsat program is that it has essentially created a new commercial industry, one that remains viable and growing. According to LDCM Project Scientist Dr. James Irons, Landsat 1 was the first non-weather civilian satellite dedicated to monitoring phenomena on the land surface of the Earth. Previous Earth-observing satellites were either designed to monitor weather, or were intended for military purposes.

Landsat 1 and its early successors demonstrated that observing Earth from a space-based platform over an extended period of time was technically possible. This in turn encouraged other entities, including private companies, to develop and launch their own Earth observation instruments.

Today applications and products associated with Earth observation from space comprise a multi-billion dollar global opportunity. According to an industry report (see *http://eomag.eu/articles/604/satellite-based-earth-observation-entering-*



TIRS focal plane assembly containing the three QWIP arrays. All components shown in this image were developed specifically for LDCM. —PHOTO BY NASA

expansion-phase-with-record-high-of-nearly-200-satellites-expected-to-be-launched-by-2017-nascent-private-sector-and-emerging-government-programs-fuelling-growth) analysts expect that nearly 200 Earth-observing satellites will be launched between the years 2007 through 2017, with private industry representing one of the fastest-growing segments of this market. Major players include the U.S.-based DigitalGlobe and the Dutch company ImageSat.

Landsat Technologies Adapted for Commercial Use

From the beginning, the Landsat program has contributed spinoff technologies that have found terrestrial uses. One example is a digital imaging technique known as **whisk-broom scanning** (a.k.a. **electro-mechanical scanning**). Landsat 1 employed whisk-broom scanning to collect digital images without employing a shutter. Instead the system employs an oscillating mirror that sweeps the field of view. Landsat established whisk-broom scanning as a viable technology; and it was used on all subsequent Landsat missions up to Landsat 8, which uses long arrays of detectors across the focal plane. Whisk-broom scanning has also been applied to many other remote sensing satellite missions.

Another technological innovation developed for Landsat is the **Quantum Well Infrared Photodetector (QWIP) Focal Plane Assembly** (GSC-15849-1) developed for the TIRS instrument.

TIRS incorporates three large format infrared detecting arrays based on QWIP technology onto a common focal plane, providing precision alignment of all three arrays. This enables Landsat 8 to provide critical data for global water resource management. Other applications under consideration for QWIP-based instruments include military (such as landmine detection) and environmental monitoring (for example oil spills). QWIP is also being considered for non-space applications such as medical diagnostics.

Note that the general concept of building larger focal planes on a single silicon substrate may have application to other focal plane based applications. In addition, NASA Goddard's partner QmagiQ has leveraged QWIP technology to deliver commercial systems designed for sensor engines and camera systems.

Other LDCM-related technologies with potential for terrestrial applications include:

- **Focal plane front-end electronics for TIRS (GSC-16057-1)** converts the TIRS analog signals to digital format, and then send this data to a computer via a USB serial link. To do this, the FPE converts electrical power from generic power supplies to the bias power needed by the FPA. The FPE also generates digital clocking signals and shifts the typical transistor-to-transistor logic (TTL) to +/- 5 volts required by the FPA. A commercial company has expressed interest in using it for a global survey application under a Space Act Agreement.
- **TIRS Single Crystal SiliconScene Select Mirror (GSC-16515-1)** is a robust mirror for mounting where flexures may not be fully optimized. Vibration testing has determined that this mirror provides superior mechanical performance to an aluminum substrate mirror, with no need for notching. In addition, cold figure testing of the mounted mirror indicated that all LDCM optical requirements are met, including cold figure and repeatability. This mirror has been qualified for space flight use to the TIRS environmental qualification requirements.

Landsat 8 Continues the Tradition

This article touches upon only a few of the many ways Landsat data, and the program itself, has benefitted Earth science – while helping to launch multiple new commercial sectors and industries. In this way, LDCM/Landsat 8 represents the latest chapter of an ongoing NASA success story, one that abundantly demonstrates the often incalculable return provided by investment in space science.

LDCM/Landsat 8 Year in Review

One of the major 2013 NASA Goddard events occurred on February 11 with the launch of the Landsat Data Continuity Mission (LDCM), which after three months in operation assumed the name Landsat 8. This mission is the eighth of a series of Earth-observing satellite missions jointly managed by NASA and the United States Geological Survey.

LDCM incorporates cutting-edge technologies for capturing detailed Earth surface features across a wide spectrum of visible and infrared bands. Together with the still-operational Landsat 7, these two satellites observe every spot on the globe at least once every eight days.

Landsat Data Continuity Mission (Landsat 8) lifts off. **—PHOTO BY NASA**

The Operational Land Imager (covered with white Tedlar insulation) and the Thermal Infrared Sensor (covered in gold foil) mounted on LDCM. **—PHOTO BY NASA**

NASA Goddard Instruments on Landsat

NASA Goddard developed two primary instruments for LDCM/Landsat 8, the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). Together these instruments record terrestrial surface features in the visible, near infrared, shortwave infrared, and thermal infrared wavelengths. OLI provides two new spectral bands, one tailored especially for detecting cirrus clouds and the other for coastal zone observations. TIRS collects data for two additional narrow spectral bands in the thermal region, formerly covered by only one wide spectral band on previous Landsat missions, to measure Earth's thermal energy.

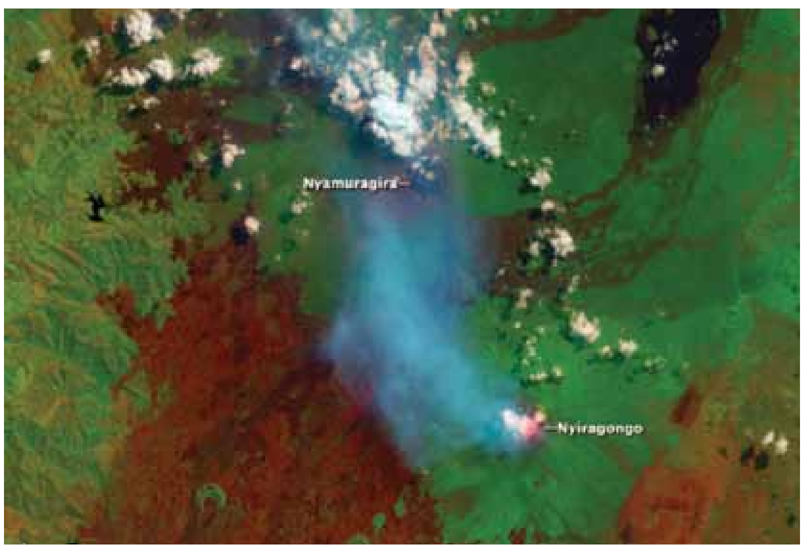
The data collected by the mission's OLI and TIRS instruments is now available to download at no charge from GloVis, EarthExplorer, or via the LandsatLook Viewer. This data is processed to be consistent with archived data from previous Landsat missions. Data products will be delivered as 16-bit images.

The OLI and TIRS sensors deliver improved signal-to-noise performance quantized over a 12-bit dynamic range. This translates into 4096 potential grey levels in an image (compared with 256 grey levels in previous 8-bit instruments). This provides enhanced characterization of land cover state and condition.

Throughout 2013, Landsat 8 contributed to the program's critical role in monitoring, understanding, and managing Earth resources. In the process, it continues to add to Landsat's comprehensive database of Earth Science data.

Landsat 8 Images Congo Volcanoes

For example, in July Landsat 8 recorded images of two volcanoes in the African nation of Democratic Republic of the Congo, These two volcanoes, named Nyamuragira and Nyiragongo, are among the most active on our planet.



Landsat 8 image of Nyamuragira and Nyiragongo —PHOTO BY NASA

Nyiragongo features a persistent lava lake, which in the preceding image appears as a red glow of shortwave infrared light. Note also the dense, white plume drifting from Nyamuragira. The color indicates that this plume includes a large amount of water vapor. In the surrounding landscape, forest appears as bright green, cleared areas as red-brown, and old lava flows various shades of black, brown, and green.

Landsat 8 Records California Drought

Two Landsat 8 images, one taken in November of 2013 and the other taken in early January 2014, provide visual proof of the severity of the ongoing drought in the state of California. These pictures, captured by the OLI instrument, show a dramatic decrease in the amount of snow cover on the slopes of California's Mount Shasta. In the earlier photograph the mountain looks mostly white. But in the January image, the south, west and eastern slopes of Mount Shasta are almost entirely bare.

Normally Mount Shasta is completely covered in snow in January. The current snow cover is estimated to be less than 5 percent of the typical peak cover, which usually occurs in early April

U.S. National Research Council Calls for Sustained Landsat Program

The U.S. National Research Council (NRC) on August 8 released a report that recommends ongoing commitment to the Landsat program. This report, titled "Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program," calls for a "systematic and deliberate program" to ensure that there is no disruption of service in Landsat's mission to compile an ongoing and uninterrupted record of moderate-resolution imagery of the Earth's land surface. The report further recommends that the U.S. government establish a comprehensive national strategy and long-term commitment for a sustained and enhanced land imaging program. This program needs to include clearly defined requirements, management responsibilities, and stable funding.

2013 TECHNOLOGY DISCLOSURES

Disclosures

- JLAB TRACKING TOOL (JTRAK)

  Arlene Bigel

- ADVANCED P-BAND SPACEBORNE RADAR SYSTEM

  Rafael Rincon

- GODDARD MISSION SERVICES EVOLUTION CENTER (GMSEC) CRITERIA ACTION TABLE (CAT) VERSION 5.4.1

  Michael Yang

- SPACECUBE V2.0 MICRO

  David Petrick, Alessandro Geist, Michael Lin, Gary Crum

- ELECTROMAGNETIC META-MATERIAL WITH WIDE-ANGULAR AND BROADBAND-SPECTRAL ABSORPTION

  Edward Wollack, Kongpop U-yen

- TDRS SIMULATOR (TSIM)

  Markland Benson

- LENS MOUNTS FOR CRYOGENIC OPTICAL INSTRUMENTS

  Andrew Monson, Michael Pierce

- A COMPACT TWO-STEP LASER DESORPTION/ IONIZATION TIME-OF-FLIGHT MASS SPECTROMETER FOR IN SITU PLANETARY EXPLORATION

  Stephanie Getty, William Brinckerhoff, Timothy Cornish

- GREAT (GODDARD MISSION SERVICES EVOLUTION CENTER (GMSEC) REUSABLE EVENTS ANALYSIS TOOLKIT) VERSION 2.3

  Daniel Hunke

- MICROMACHINED THERMOPILE ARRAYS WITH NOVEL THERMOELECTRIC MATERIALS

  Emily Barrentine, Shahid Aslam, Ari Brown

- BUNDLE PROTOCOL SOFTWARE LIBRARY VERSION 1.0

  Timothy Ray

- CFE/CFS EVOLUTION FOR MULTI-CORE PLATFORMS

  DwaineMolock, Alan Cudmore, David Edell, Christopher Monaco

- GRAVITE UPLOAD TOOL

  Peyush Jain

- CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS (CCSDS) FILE DELIVERY PROTOCOL (CFDP) DUMP UTILITY VERSION 1.0

  Timothy Ray

- SHAPED BEAM HIGH GAIN ANTENNA ON SINGLE AXIS TURNTABLE FOR NASAS KA-BAND COMMUNICATION APPLICATIONS

  Cornelis Du Toit, Victor Marrero-Fontanez

- ULTRA-LOW NOISE PREAMPLIFIER FOR WIDE BAND GAP DETECTORS

  Duncan Kahle, Augustyn Waczynski, Shahid Aslam, Federico Herrero

- FRONT END DATA SYSTEM (FEDS) VERSION 10.0

  Ryan Detter, Edwin Fung, Peter Gorog, Daniel Grogan, Larry Alexander, Charles Englehart, George Wofford, Thomas Green, Jeffrey Condron, James Dowling

- GRAVITE INCINERATOR

  Peyush Jain

- INFORMATION-BASED AUTOMATIC GAIN CONTROL WITH HARDWARE ACCELERATION

  Bo Naasz, Will Clement

- MIRRORLET ARRAY BASED INTEGRAL FIELD SPECTROMETER (IFS) FOR AGRICULTURE STUDY

  Qian Gong

- LAB QUALITY MANAGEMENT SYSTEM (LQMS) APPLICATION

  Gregory Wood

- DEVELOPMENT OF A METALLIC BILAYER LIFTOFF MASK

  Ari Brown

- LOW EXCESS NOISE, HIGH GAIN AVALANCHE PHOTODIODES

  Rengarajan Sudharsanan, Xiaogang Bai, PingYuan

- SOLAR PUMPED FIBER LASER FOR SOAR SAIL PROPULSION, SPACECRAFT REMOTE POWER TRANSFER APPLICATIONS FOR EARTH AND PLANETARY MISSION

  Donald Coyle, Paul Stysley, Demetrios Poulios

- DISTRIBUTED INTEGRATED MODULAR AVIONICS (DIMA) HARDWARE AND SOFTWARE REFERENCE ARCHITECTURE

  Jonathan Wilmot, Glenn Rakow

- SPACECUBE V. 2.0 FLIGHT POWER CARD

  David Petrick, Pietro Sparacino, Milton Davis,

- **FOCUSING ROLLER NUT**

  Michael Williams

- LABNOTES: A MOBILE APP FOR INSTRUMENT CONTROL AND DATA COLLECTION

  Troy Ames, Emily Steel, Carl Hostetter

- SMAP RADIOMETER L1A PACKET DATA PROCESSING, USING ALGORITHMS PREVIOUSLY DEVELOPED IN MATLAB BY OTHERS, IS CONVERTED TO ANSI C CODE

  Elisabeth Brinker

- SMAP RADIOMETER CCSDS DATA PACKET INPUT PROCESSOR IN ANSI C.

  Elisabeth Brinker

- OBS4MIPS.PY

  Denis Nadeau

- 3-DIMENSIONAL PHOTOVOLTAICS ARRAY FOR LASER BASED POWER TRANSFER

  Donald Coyle

- ROBOTIC GRIPPER FOR AUTONOMOUS RENDEZVOUS AND CAPTURE OF SATELLITES

  Matthew Ardmore

- FLIGHT PROCESSOR VIRTUALIZATION FOR SIZE, WEIGHT, AND POWER REDUCTION (FY13 IRAD)

  Alan Cudmore, Justin Rice

- GMSEC REMOTE APPLICATION SERVICE PROVIDER (GRASP) 2.0

  Matthew Handy, Thomas Grubb

- INVESTIGATION OF WAVE-PARTICLE INTERACTIONS IN SOLAR WIND ACCELERATION REGION

  Nojan Omidi

- ELECTRONICS MINIATURIZATION WITH A SYSTEMONACHIP FOR POWER SYSTEMS

  Amri Hernandez-Pellerano, Jeffrey DuMonthier, Robyn King

- EVOLUTIONARY MISSION TRAJECTORY GENERATOR (EMTG)

  Jacob Englander

- THE JPSS DPE BINARY LUT/ FILE READER AND EDITOR

  Sergei Gusev, William Ardanuy, Alice Issacman, Adam Hollidge

- INTERCALIBRATION OF MEASUREMENTS FROM MICROWAVE SENSORS FOR TRMM AND GPM USING A WELL VALIDATED RADIATIVE TRANSFER CODE

  Jean-Luc Moncet

- THE MICRORADIOMETER AS AN INTELLIGENT (I.E., PROGRAMMABLE OR SMART) PHOTODETECTOR

  Stanford Hooker, Charles Booth, Randall Lind, John Morrow

- HAZARDS ANALYSIS MANAGEMENT TOOL

  Chad Schaeffer, John Schmidt

- TASS-ENHANCED NEAR EARTH NAVIGATION EXPERIMENT

  Peter MacDoran, Kenn Gold, Michael Matthews, Michael Davies

- CROSS SUPPORT TRANSFER SERVICE FRAMEWORK SOFTWARE LIBRARY VERSION 1.0

  Timothy Ray

- METHOD FOR PROTECTING THIN FILM LAYERS FROM DAMAGE DURING DEVICE PROCESSING

  Kevin Denis, George Manos, Erik Crowe

- EEPROM FILE SYSTEM

  Alan Cudmore, Steven Slegel

- BACK-TO-BACK HIGH DENSITY CONNECTOR ON A CIRCUIT BOARD TO INCREASE INTERCONNECT DENSITY

  David Petrick

- LAYOUT TECHNIQUES FOR DUAL SIDED PRINTED CIRCUIT BOARD (PCB) INCORPORATING FINE PITCH COLUMN GRID ARRAY DEVICES TO MEET IPC CLASS 3/A MANUFACTURING SPECIFICATIONS

  David Petrick, Luan Vo, Dennis Albaijes

- WEB MONITORING OF EVENTS REMOTELY (WEBMERE) 1.0

  Thomas Grubb, Matthew Handy

- GRAVITE PLANNER

  Peyush Jain

- GRAVITE DATABASE

  Peyush Jain

- A METHOD OF LIVE-CELL IMAGING AND FLUID EXCHANGE FOR A LAB-ON-CHIP CLINOROTATION SYSTEM

  Alvin Yew, Javier Atencia-Fernandez

2013 TECHNOLOGY DISCLOSURES

- 3D PLUS PROGRAMMABLE READ ONLY MEMORY (PROM) PROGRAMMING PROCEDURE

  Jonathan Boblitt, David Petrick, Alessandro Geist

- SPACE NETWORK ACCESS SYSTEM (SNAS)

  Keiji Tasaki, Rosemarna (Rose) Pajerski, Helaleh Mag hsoudiou

- DIGITALLY STEERED PHASED ANTENNA ARRAY FOR GPS APPLICATIONS

  Luke Winternitz, Heitor Pinto, Jennifer Valdez, Samuel Price, Lawrence Han, Monther Hasouneh

- GRAVITE DISTRIBUTION

  Peyush Jain

- MINIATURIZED RADIATION HARDENED BEAM-STEERABLE GPS RECEIVER

  Michael Shaw

- BUG FIXES AND UPGRADES TO OU/NOAA'S EF5 ENSEMBLE MODELING FRAMEWORK, AND THE COUPLED ROUTING AND EXCESS STORAGE (CREST)

  John David, Zac Flamig

- ADVANCED TOOL DRIVE SYSTEM (ATDS) - TOOL DRIVE END EFFECTOR (TDEE) A COMBINED ROBOTIC TOOL CHANGE-OUT MECHANISM AND TOOL DRIVE INSTALLED AT THE END OF ROBOT ARM; COUPLER - A 3-JAW LATCH SYSTEM THAT GRASPS A MATING INTERFACE PLATE ON EACH TOOL; DRIVE ACTUATORS CAN TRANSFER TORQUE TO MATING SPLINES OF A TOOL, TO PROVIDE ROTARY OR LINEAR MOTION

  Paul Nikulla, Alejandro Rivera, Edward Cheung, Thomas McBirney, Mark Behnke, Michael Liszka

- PRECIPITATION IMAGING PACKAGE (PIP)

  Francis Bliven

- MAGNETIZING DRY LUBRICANTS AND BEARING SURFACES FOR EASY CAPTURE WITH A MAGNETIC TRAP

  S. Harvey Moseley

- CLOSED-FORM (ANALYTICAL) SEW-ANGLE INVERSE KINEMATIC SOLUTION FOR THE 7-DOF FREND ROBOTIC ARM

  Will Clement, Hui An

- MULTI-MISSION PLANNING TOOL (MMPT) FOR EARTH SCIENCES FLIGHT OPERATIONS (TERRA, AQUA, AURA)

  Jon Touchstone, Pete Johansen, David Bykowski, Jody Caldwell

- A REDUCED-COST CHIRPED PULSE FOURIER TRANSFORM MICROWAVE SPECTROMETER USING DIRECT DIGITAL SYNTHESIS

  Ian Finneran, Daniel Holland, P. Carrol, Geoffrey Blake

- MINIATURE RELEASE MECHANISM OR DIMINUTIVE ASSEMBLY FOR NANOSATELLITE DEPLOYABLES (DANY)

  Luis Santos, Scott Hesh, John Hudeck

- EXTRAVEHICULAR ROBOTIC (EVR) NOZZLE TOOL (ENT)

  Matthew Ashmore

- PROPELLANT TRANSFER ASSEMBLY DESIGN AND DEVELOPMENT

  Phillip Kalmanson, Brian Nufer, Stephen Anthony, Craig Fortier

- RELEASE OF A STUCK SOLAR ARRAY OR ANTENNA - CONCEPTS

  Paul Nikulia, Michael Liszka, Alejandro Rivera, Edward Cheung, Thomas McBirney, Mark Behnke

- GEO-REGISTRATION OF MULTI-SOURCE IMAGE DATA FOR SENSORWEB APPLICATIONS

  Jacqueline Le Moigne-Stewart, Daniel Mandl, Vuong Ly, Patricia Sazama

- CHEMICAL SENSORS BASED ON 2-DIMENSIONAL MATERIALS

  Mahmooda Sultana

- OPTICALLY MODULATED MINIATURE MAGNETOMETER (OMMM)

  Andy Brown, Robert Slocum

- DAMAGE-FREE FINISHING OF SILICON X-RAY OPTICS USING MAGNETIC FIELD-ASSISTED FINISHING

  Hitomi Greenslet, Raul Riveros

- THREE SOFTWARE PLUGINS FOR THE NASA GMAT (GENERAL MISSION ANALYSIS TOOL) MISSION DESIGN SOFTWARE:
  1. AUTO CONTINUATION PLUGIN FOR PLOTTING FAMILIES OF PERIODIC ORBITS.
  2. DMOC PLUGIN FOR OPTIMAL CONTROL SUBJECT TO CONSTRAINTS.
  3. ARENA PLUGIN FOR STATE ESTIMATION.

  Randy Paffenroth, Kyle Tarplee, Woody Leed, Philip Du Toit

- NEGATIVE ION TIME PROJECTION CHAMBER POLARIMETER FOR MEASURING THE POLARISATION OF BRIGHT TRANSIENT ASTROPHYSICAL SOURCES

  Joel Black, Joanne Hill, Philip Kaaret

- META-MATERIAL BLOCKING FILTER WITH LOW GEOMETRIC INDUCTANCE

  Kongpop U-yen, Samuel Moseley, Edward Wollack

- TWO-CHANNEL 3 GSAMP/SECOND ADC AND FPGA BOARD FOR DIGITAL DOWNSAMPLING HIGH-BANDWIDTH AND HIGH DATA-RATE MICROWAVE (L-BAND) INTERFEROMETRIC OR POLARIMETRIC SIGNALS

  Paul Siqueira, Russell Tessier, Vishwas Vijayendra

- SPACE WEATHER SCOREBOARD

  Chiu Wiegand, Richard Mullinix, Marlo Maddox

- CLOSED-FORM (ANALYTICAL) SEW-ANGLE INVERSE KINEMATIC SOLUTION FOR THE 7-DOF MOTOMAN SIA-50D ROBOTIC ARM

  William Clement, Hui An

- SPACECUBE COMMUNICATION INTERFACE BOX

  Daniel Espinosa, David Petrick, Thomas Flatley, Jeffrey Hosler, Robin Ripley, Manuel Buenfil, Pietro Sparacino, Sanetra Bailey, David Hardison

- GODDARD NATURAL FEATURE IMAGE RECOGNITION (GNFIR) ALGORITHM (SOFTWARE AND FIRMWARE)

  John Van Eepoel, Steve Queen, Nathaniel Gill, Alessandro Geist

- INFRARED MICROSPECTROMETER BASED ON MEOMS LAMELLAR GRATING INTERFEROMETER

  Michael Morley, Silviu Velicu

- FLEXIBLE HARNESS CIRCUIT DESIGN FOR CANCELLATION OF RECEIVED NOISE ONTO DATA SIGNAL LINES

  Edward Cheung

- MINIATURE LASER MAGNETOMETER (MLM)

  Andy Brown, Robert Slocum

- VISUALIZATION OF TERASCALE DATASETS WITH IMPOSTORS

  Thomas Quinn

- DEVELOPMENT OF **TECHNOLOGY FOR A COMET SAMPLE RETURN MISSION - VERSION 2**

  Joseph Nuth, Donald Wegel, Lloyd Purves, Edward Amatucci, Michael Amato

- THE DEVELOPMENT OF A NEW CRYOGENIC OPERATED SOLENOID

  Rajeev Sharma

- A PROCESS FOR MITIGATING PARTICULATE CONTAMINATION FROM BEARING SURFACES

  Samuel Moseley

- ADVANCED TOOL DRIVE SYSTEM (ATDS) - CAMERA POSITIONING MECHANISM (CPM) THE COMBINATION OF A CAMERA, LENS AND ELECTRO-MECHANICAL EXTENSION DEVICE; INSTALLED ON THE END OF A ROBOTIC ARM, BUT EQUALLY COULD BE INSTALLED AT ANY LOCATION NEEDED TO PROVIDE FOCUSED VIEWS OF A ROBOTIC WORKSITE. THE CPM HOUSES A CAMERA, LENS AND MECHANISMS WHICH EXTEND AND PITCH THE CAMERA LENS IN ORDER TO PROVIDE ROBOTIC TELE-OPERATORS WITH A VISUAL IMAGE OF WORKSITE ACTIVITIES AT THE TIP OF A TOOL ATTACHED TO THE ATDS, WHICH IS ATTACHED TO THE END OF A ROBOT ARM, OR OTHER FEATURES ON A CLIENT SATELLITE

  Edward Cheung, Jonathan Kraeuter

- ARC: ACCELERATED RELOCATION CIRCUIT FOR XILINX FPGAS

  Aravind Dasu, Ramachandra Kallam

- THERMAL-CONTRACTION MATCHED HYBRID FPA DESIGN FOR ALUMINA PACKAGES

  Donald Cooper, Lisa Fischer

- TRANSITION REGION AND CORONAL EXPLORER (TRACE) LIMIT CHECKER APPLICATION

  Michael Blau, Larry Shackleford

- PARTICULATE FILTER BASED ON GRAPHENE AND GRAPHENE DERIVATIVES FOR CLEAN AIR APPLICATIONS

  Mahmooda Sultana

- TOOL STOWAGE CANTILEVER LAUNCH LOCK

  Richard Michael, William Squicciarini

- ADVANCED TOOL DRIVE SYSTEM (ATDS) - BLDC MOTORS BRUSHLESS DC ELECTRIC MOTORS USED INSIDE THE ATDS TO PROVIDE TORQUE TO THE FOUR ACTUATORS - COUPLER DRIVE, LINEAR DRIVE, INNER ROTARY DRIVE AND OUTER ROTARY DRIVE. DRIVE ACTUATORS CAN TRANSFER TORQUE TO MATING SPLINES OF A TOOL, ATTACHED TO THE ATDS, TO PROVIDE ROTARY OR LINEAR MOTION

  Paul Nikulia, Michael Liszka, Alejandro Rivera, Edward Cheung, Thomas McBirney, Matthew Ashmore, Mark Behnke

2013 TECHNOLOGY DISCLOSURES

- 2.2 MICRON, UNCOOLED, INGAAS PHOTODIODES AND BALANCED PHOTORECEIVERS UP TO 25 GHZ BANDWIDTH

  Abhay Joshi

- INTEGRATED COMPOSITE — HEATPIPE RADIATOR PANEL

  Mark Montesano

- COMPACT APPARATUS FOR MEASURING THE SEEBECK COEFFICIENT OF THIN METALLIC FILMS

  Emily Barrentine, Ari Brown

- VIDEO DISTRIBUTION & STORAGE UNIT (VDSU) SSCO RESTORE PROGRAM

  Madhu Kadari, Serge Svovsky, Seshagiri Nadendla

- SPACE WEATHER DATABASE OF NOTIFICATIONS, KNOWLEDGE, INFORMATION (DONKI)

  Richard Mullinix, Chiu Wiegand, Mario Maddox

- DEVELOPMENT OF A DIFFUSE COATING WITH HIGH ABSORPTANCE FOR MULTILAYER INSULATION COVER TO MINIMIZE SUNLIGHT GLINT TO CAMERAS IN FLIGHT

  Michael Choi, Kenneth O'Connor, Mark Hasegawa

- INTELLIGENT PAYLOAD MODULE

  Daniel Mandi, Vuong Ly, Matthew Handy

- RADIATION HARDENED 10BASE-T ETHERNET PHY

  Michael Lin, Kevin Ballou, Daniel Espinosa, Edward James, Matthew Kliesner, David Petrick

- MAVEN FLIGHT AND GROUND SOFTWARE

  Lawrence Ellis, Angela Boggs, Gregory Bollendonk, Kristina Bogar, Sibel Clark, Martin Coltrin, Jason Dates, William Fehringer, Paul Fleming, Jeffrey Harris, Janet Hatstat, Geoffrey Hauser, David Hirsch, Mary Klaus, Karl Langas, Edward Lichtenfels, Matthew McIllese, Trevor Merkley, Lorn Miller, Doug Niebur, Yegor Plam, Randy Pletzer, Monte Ratajczyk, Paul Roberts, Mark Scott, Jay St. Pierre, Michael Stevens

- NON-LINEAR NON-STATIONARY ANALYSIS OF 2D TIME SERIES APPLIED TO GRACE DATA

  Scott Luthcke, Nicolas Gagarin

- COMPOSITE CAPACITIVE TACTILE/FORCE SENSOR ARRAYS FOR ROBOTIC SPACE APPLICATIONS

  Edward Sabolsky, Timothy Weadon, Thomas Evans

- PHASE OCCULTED VISIBLE NULLING CORONAGRAPH

  Richard Lyon, Mark Clampin, Peter Petrone

- HIGH-ENERGY INSTRUMENTATION FOR SMALL SATELLITE PLATFORMS

  Georgia De Nolfo

- COMPACT LIGHT TRAP VENT

  Francisco San Sebastian

- FLIGHT HARDWARE VIRTUALIZATION FOR SCIENCE DATA PROCESSING (FY12 IRAD)

  Alan Cudmore, Justin Rice

- A MICRO CYLINDRICAL ION TRAP (U-CIT) MICRO MASS SPECTROMETER INSTRUMENT SYSTEM (UMSIS) FOR NASA PLANETARY EXPLORATION

  Patrick Roman, William Brinckerhoff, George Manos, Kyle Gregory

- RELEASE OF A STUCK SOLAR ARRAY OR ANTENNA - ADDITIONAL CONCEPTS

  Alejandro Rivera, Paul Nikulia, Michael Liszka, Thomas McBirney, Mark Behnke

- ADVANCED MISSION DESIGN AND NAVIGATION ANALYSIS

  Gregory Marr

- A RADIATION HARDENED QUAD 12-BIT DIGITAL-TO-ANALOG CONVERTER APPLICATION SPECIFIC INTEGRATED CIRCUIT

  George Suarez, Jeffrey DuMonthier, Nikolaos Paschalidis

- POSE ALGORITHM FOR RANGE IMAGES

  Matthew Strube, Nathaniel Gill, Joseph Galante, John Van Eepoel

- HIGH REFLECTANCE SILICON DIELECTRIC MIRRORS FOR INFRARED ASTRONOMY

  Kevin Denis, Edward Wollack, Samuel Moseley, Manuel Quijada

- FABRICATION OF AN INTEGRATED PHOTONIC WAVEGUIDE JOINT IN MICROMACHINED SILICON

  Kevin Denis

- FAILURE ANALYSIS OF DIELECTRIC BREAKDOWNS IN BASE-METAL ELECTRODE MULTILAYER CERAMIC CAPACITORS

  David Liu, Ronald Weachock

- GRAVITE UPLOAD TOOL

  Peyush Jain, Richard Ullman, Wayne McCullough, David Trang, Chintu Mistry, Ryan Gerard, Shyam Vyas, Michael Iwunze, Angelo Bertolli

- CUBESAT FORM FACTOR THERMAL CONTROL LOUVERS

  Allison Willingham

- LOW POWER THERMONIC EMISSION ELECTRON GUN OPERATING AT 1 ATMOSPHERE

  Fred Minetto

- MM-WAVE RADIOMETER FRONT-END DEVELOPMENT

  Negar Ehsan, Matthew McLinden, Jared Lucey

- GIGABIT PER SECOND DATA PROCESSING

  Teresa Sheets, Stanley Hunter

- METHOD AND DEVICE FOR EXTRACTING LIQUIDS FROM A SOLID PARTICLE MATERIAL

  Benjamin de Mayo

- FABRICATION OF SI LEG-ISOLATED BI-CR THERMOPILES

  Ari Brown, Vilem Mikula, Elbara Ziade

- TECHNIQUES FOR ON-ORBIT CRYOGENIC SERVICING

  Charles DeLee, James Tuttle, Xiaoyi Li, Jill McGuire, Michael DiPirro, Susan Breon, Robert Boyle, Peter Barfknecht, Julia Huynh, Shouvanik Mustafi

- 1 MICRON (1064 NM) PLANAR EXTERNAL CAVITY LASER - PLANEX

  Mazin Alalusi, Georgios Margaritis, Lew Stolpner

- NASA SOIL MOISTURE ACTIVE PASSIVE MISSION (SMAP) RADIOMETER INSTRUMENT LEVEL 1-B (L1B) SCIENCE SIGNAL AND DATA PROCESSING SOFTWARE (SPS) FOR RADIO FREQUENCY INTERFERENCE (RFI) DETECTION AND MITIGATION (L1B SPS RFI)

  Semion Kizhner, Matthew Brandt, Jeffrey Piepmeier

- HELIO RADIO CUBESAT LUNAR EJECTION SYSTEM (HERCULES)

  Elizabeth Daly, Elizabeth Blaiszik, Robert MacDowall, Fred Minetto

- NEUTRON SPECTROMETER FOR INNER RADIATION BELT STUDIES (IRAD FY14)

  Georgia De Nolfo, David Sohi

- FEMTO-SATELLITE SENSOR NODES FOR DISTRIBUTED SPACE MISSIONS

  Kyle Gregory, Luke Winternitz, Rafael Garcia, Jennifer Valdez, Steven Kenyon, Juan Rodriguez-Ruiz, Nikolaos Paschalidis, Shannon Rodriguez, Penina Axelrad

- SPF: A SOFTWARE FRAMEWORK FOR PSEUDOSPECTRAL NUMERICAL SIMULATION AT EXTREME SCALES

  Thomas Clune

- A RADIATION HARDENED QUAD 10-BIT DIGITAL-TO-ANALOG CONVERTER APPLICATION SPECIFIC INTEGRATED CIRCUIT

  George Suarez, Jeffrey DuMonthier, Nikolaos Paschalidis

- WALD SEQUENTIAL PROBABILITY RATIO TEST FOR SPACE OBJECT CONJUNCTION ASSESSMENT

  James Carpenter, F. Markley

- MAREA ZERO - A HIGH PERFORMANCE MIDDLEWARE LAYER FOR GMSEC BASED ON ZEROMQ

  Juan Lopez Rubio

- HOSE FOR IN-SPACE PROPELLANT TRANSFER BETWEEN TWO SATELLITES

  Syrus Jeanes, Erik Tormoen, Antonio Pego, Cara Evers, Tom Ebert, Craig Fortier, Michael Stirling, Philip Kalmanson

- ELASTIC DEPLOYABLE COMPOSITE TUBULAR ROLL-OUT BOOM

  Brian Spence, Mark Douglas

- METHOD AND LABORATORY SETUP FOR IMAGING TAPE LIFTS BY AUTOMATED MICROSCOPY

  Alfred Wong, Taylor Fetrow, Nancy Carosso, Mark Hasegawa

- GRAVITE PULL SERVER

  Peyush Jain, Richard Ullman, Wayne McCullough, David Trang, Chintu Mistry, Ryan Gerard, Shyam Vyas, Michael Iwunze, Angelo Bertolli

- NASA SOIL MOISTURE ACTIVE PASSIVE MISSION (SMAP) RADIOMETER INSTRUMENT LEVEL 0-B (L0B) SCIENCE SIGNAL AND DATA PROCESSING SOFTWARE (SPS) FOR PROCESSING OF SMAP SPACECRAFT RADIOMETER TELEMETRY FRAME (TF) FILES (L0B SPS) AND GENERATING A HALF-ORBIT FILE THE UNIT OF DATA INPUT TO THE SMAP SCIENCE DATA PROCESSING GROUND SYSTEM

  Semion Kizhner, Matthew Brandt

- TOOL STOWAGE PRIMARY LAUNCH LOCK/SOFT DOCK

  Kelvin Garcia, Michael Garrah, William Squicchiarini

- SCIENCE-DEFINED SOFTWARE RADIO

  Damon Bradley

2013 TECHNOLOGY DISCLOSURES

- COST AND RISK ANALYSIS OF SMALL SATELLITE CONSTELLATIONS FOR EARTH OBSERVATION

  Sreeja Nag, Jacqueline LeMoigne-Stewart, Olivier de Weck, Charles Gatebe

- MICROMACHINED INTEGRATED PACKAGE WITH HIGH THROUGHPUT AND WIDE-REJECT-BAND FOR BOLOMETRIC SENSORS

  Edward Wollack, Kongpop U-yen, David Chuss, Kevin Denis

- WAVESPAR INSTRUMENT FOR ATMOSPHERIC COLUMN MEASUREMENTS OF METHANE AND CARBON DIOXIDE OVER OCEANS AND LARGE BODIES OF WATER

  Emily Wilson

- CONTROLS AND OPERATIONS SYSTEM OF A PROPELLANT TRANSFER PAYLOAD FOR GEO SATELLITES

  Brian Nufer, Erik Tormoen, Cara Evers, Westly Mosedale, Lorenzo Locante, Philip Kalmanson

- CONCEPT DEVELOPMENT FOR ADVANCED SPACEBORNE SYNTHETIC APERTURE RADAR

  Rafael Rincon, Kenneth (Jon) Ranson, Temilola Fatoyinbo, Lynn Carter

- WAYPOINT INSPECTION PROFILE

  Matthew Strube, Brent Barbee, Bo Naasz

- DESIGN AND CONSTRUCTION OF LARGE-APERTURE CRYOGENIC POLARIZERS WITH HIGHLY UNIFORM SPACING

  David Chuss, Paul Mirel, Alan Kogut, Edward Wollack

- COMMUNITY TOWN-SQUARE WEB-BASED COLLABORATIVE ENVIRONMENT (TOWN SQUARE)

  Robert Menrad, Sophia Marnell

- SCIENTIFIC BALLOONS AS SOLAR SAILS

  David Batchelor

- PHOTONIC WAVEGUIDE CHOKE JOINT WITH IMPROVED STOP-BANDWIDTH

  Kongpop U-yen, Edward Wollack

- AIRBORNE FLIGHT-ABLE PRECISION AND FAST TUNABLE SEED-LASER SYSTEM

  Jeffrey Chen, Stewart Wu

- HIGHLY ADAPTIVE PRIMARY MIRROR HAVING EMBEDDED ACTUATORS, SENSORS AND NEURAL NET CONTROL

  David Pearson

- GUIDANCE AND TARGETING FLIGHT SOFTWARE

  Matthew Strube, John Van Eepoel

- 3D PLUS PROGRAMMABLE READ ONLY MEMORY (PROM) EMULATOR BOARD

  Alessandro Geist, David Petrick

- GODDARD MISSION SERVICES EVOLUTION CENTER (GMSEC) SECURE APPLICATION PROGRAMMING INTERFACE (API) MODULE VERSION 2.0

  Robert Wiegand, Vuong Ly, Matthew Handy

- ANALYSIS TOOL FOR HARTMANN MEASUREMENT DATA OF COMPONENTS OF X-RAY TELESCOPES

  Timo Saha, Michael Biskach, William Zhang

- A NOVEL MICROFABRICATION PROCESS FOR BUILDING THIN, LARGE AREA, SUSPENDED X-RAY ABSORBERS FOR LOW ENERGY X-RAY SPECTROSCOPY

  Thomas Stevenson, Manuel Balvin, Kevin Denis, John Hagopian

- “GODDARD TUNNEL” AKA GTUN

  Mark Sinkiat, Gregory Menke

- CONFORMAL NANOTUBE BAFFLE FOR A COMPACT CORONAGRAPH (IRAD) STEP-2 PROPOSAL FY14 IRAD

  Peter Chen, Manuel Quijada, Gregory Hildrobo, Karrie Houston, Qian Gong, Douglas Rabin, Vivek Dwivedi

- CONTINENTAL-SCALE MAPPING OF ADLIE PENGUIN COLONIES FROM LANDSAT IMAGERY

  Matthew Schwaller, Colin Southwell, Louise Emmerson

- FLIGHT PROVING A HELIOPHYSICS SOFT X-RAY IMAGER

  David Sibeck, Michael Collier, Frederick Porter

- INHIBIT UNIT (IU) FOR PROPULSION & DEPLOYMENT ELECTRONICS (PDE) SYSTEM FOR THE LUNAR RECONNAISSANCE ORBITER (LRO) MISSION

  Jason Badgley

- OPTICAL ALIGNMENT OF THE GLOBAL PRECIPITATION MEASUREMENT (GPM)

  Samuel Hetherington, Dean Osgood, Joseph McMann, Vicki Roberts, James Gill, Kyle McLean

- ATOMIC INTERFEROMETER GRAVITY GRADIOMETER (AIGG) FY13 IRAD

  Scott Luthcke

- PHASE II FINAL FOR DOMAIN ENGINEERED MAGNESIUM OXIDE DOPED LITHIUM NIOBATE FOR LIDAR-BASED REMOTE SENSING

  Martin Fejer, Philip Battle, Carsten Lengrock

- SATELLITE SITUATION UPDATE (SSUP)

  Eric Stoneking

- MODULAR PROPULSION & DEPLOYMENT ELECTRONICS (PDE) SYSTEM FOR THE LUNAR RECONNAISSANCE ORBITER (LRO) MISSION

  Jason Badgley

- KA-BAND SPACEFLIGHT COMMUNICATIONS SYSTEM(S)

  Cornelis Du Toit, Kenneth Hersey, Jeffrey Jaso, Victor Marrero-Fontanez, Wei-chung Huang, Shannon Rodriguez

- DEVELOPMENT OF A SET OF FREE MOLECULE FLOW EQUATIONS FROM A TRANSIENT, ASYMMETRIC, SPHERICAL SOURCE

  Michael Woronowicz

- SPACECRAFT ON A CHIP

  Michael Lin, Sabrena Heyward, Damaris Guevara, Anthony Banes

- REAL TIME GRAPHICAL PROCESSING UNIT RAY TRACING

  Nathaniel Gill, Sean Semper

- GEOCAPE AIRBORNE SIMULATOR (GCAS)

  Scott Janz, John Riley

- RADIO FREQUENCY INTERFERENCE (RFI) MITIGATION FOR THE SOIL MOISTURE ACTIVE PASSIVE (SMAP) MICROWAVE RADIOMETER

  Jeffrey Piepmeier, Joel Johnson, Priscilla Mohammed, Damon Bradley, Christopher Ruf, Rafael Garcia, Derek Hudson, Lynn Miles

- IMPROVEMENT TO THERMONIC EMISSION 1 ATMOSPHERE ELECTRON GUN

  Fred Minetto

- MULTIPLEXED SUPERCONDUCTING NANOWIRE DETECTOR ARRAY (IRAD) STEP-2 PROPOSAL

  John Hagopian, Shahram Shiri, Samuel Moseley, Thomas Stevenson

- SPOOL GRIP FIXTURES

  Justin Jones, James Magargee, Fabrice Morestin, J. Cao

- HYPERSPECTRAL SINGLE PIXEL IMAGE SENSOR (HYPERSPI) STEP-2 IRAD PROPOSAL

  Englin Wong, Damon Bradley, Asmita Korde, Matthew Bolcar

- GRAVITE DATABASE

  Peyush Jain, Richard Ullman, Wayne McCullough, David Trang, Chintu Mistry, Ryan Gerard, Shyam Vyas, Michael Iwunze, Angelo Bertolli

- NORMALLY-CLOSED ZERO-LEAK VALVE WITH MAGNETOSTRICTIVE ACTUATOR

  Daniel Ramspacher, James (Jim) Richard

- ADAPTIVE TRAJECTORY DESIGN (ATD) FOR CIS-LUNAR AND LIBRATION ORBITS

  David Folta, Amanda Haapala, Thomas Pavlak, Kathleen Howell

- INTEGRATED COMMAND-TELEMETRY COLLABORATION ENVIRONMENT (ICCE)

  Kim Pham, Colin Vogel, John Higinbotham, Terissa Mayorga

- RESTORE SPINNING REEL HOSE MANAGEMENT SYSTEM

  Gabor Tamasy, Erik Tormoen

- NEXT GENERATION HIGH DATA RATE KA-BAND MODULATOR AND TRANSMITTER

  Wei-chung Huang, Jeffrey Jaso

- KA-BAND GATEWAY (KAG)

  Marco Midon

- FREQUENCY DIVERSITY TECHNIQUE FOR SPACE-BORNE RADAR DOPPLER MEASUREMENTS

  Lihua Li, Matthew McLinden, Gerald Heymsfield, James Carswell, Michael Coon

- DISTRIBUTED BRAGG REFLECTION SOLID STATE LASER IN PHOTO-THERMO-REFRACTIVE GLASS

  Larissa Giebova, Julien Lumeau, Leonid Glebov, Oleksly Mokhun, Vadim Smirnov, Aleksandr Ryasnyanskly

- NEW FOCAL PLANE ASSEMBLY (FPA) FOR NEXT GENERATION PLANETARY THERMAL IMAGING (TIM) INSTRUMENTS

  Gerard Quilligan, Ari Brown, Emily Barrentine, Brook Lakew, Shahid Aslam

2013 TECHNOLOGY DISCLOSURES

- HSEGLEARN - A TOOL FOR LEARNING THE OPTIMAL HIERARCHICAL SEGMENTATION LEVELS FOR REPRESENTING A SELECTED GROUND COVER TYPE

  James Tilton, Eric Brown De Colstoun, Robert Wolfe, Chengquan Huang, Sarah Smith, Jacqueline Philips, Bin Tan, Panshi Wang, Pui-Yu Ling

- GATED CHOPPER INTEGRATOR (GCI)

  Gerard Quilligan, Shahid Aslam

- EARTH UPDATE

  Colin Law, Patricia Reiff

- LOTUS WET CHEMISTRY NANO-TEXTURED DUST MITIGATION COATING WITH HYDROPHOBIC PROPERTIES, SECOND GENERATION (LOTUS WC2 COATING)

  Sharon Straka, Mark Hasegawa, Kenneth O'Connor, Victoria Pederzani Stotzer, Wanda Peters, Danielle Margiotta, Kritin McKittrick

- SPACECRAFT BERTHING MONITORING SYSTEM FOR AUTONOMOUS RENDEZVOUS AND DOCKING OPERATIONS

  Powsiri Klinkachorn, Jason Battin

- A DUAL I2C AND SPI SLAVE CORE FOR FPGA AND ASIC IMPLEMENTATIONS

  George Suarez, Jeffrey DuMonthier, George Winkert

- DATA ACCESS TOOLKIT (DAT) BUILD 1

  Chiu Wiegand, Brian Feldman, Karen Keadle-Calvert

- SPACECRAFT DESIGN AND LAUNCH DISPENSER FOR DUAL SATELLITE LAUNCH

  Carey Lively, Eric Thorstenson

- ROBOT FOR THE CONTROLLED DEPOSITION OF MULTILAYER THIN FILM STRUCTURES

  Scott Rommel, Scott Davis, Seth Johnson, Michael Anderson

- PRECISION THERMAL DETECTOR CONDUCTANCE DEFINITION WITH BALLISTIC THERMAL TRANSPORT

  David Chuss, Edward Wollack, Kevin Denis, Samuel Moseley, Karwan Rostem

- GRAVITE MONITOR

  Peyush Jain, Richard Ullman, Wayne McCullough, David Trang, Chintu Mistry, Ryan Gerard, Shyam Vyas, Michael Iwunze, Angelo Bertolli

- MULTI-BAND HYDROLOGICAL RADAR

  Paul Racette, Lihua Li, Gerald Heymsfield, Thomas Hand, Michael Cooley, Richard Park

- CORE FLIGHT SYSTEM (CFS) SOFTWARE BUS NETWORK APPLICATION VERSION 1.0

  Jonathan Wilmot, Robert McGraw

- AUTONOMIC ANALYTICS

  Roy Sterritt, Michael Hinchey

- PHOTOLITHOGRAPHIC MATCHED MICROWAVE BLOCKING FILTER

  Kongpop U-yen, Edward Wollack

- DEVELOPMENT OF HIGH CONTRAST LENSLETS FOR INTEGRAL FIELD SPECTROSCOPY

  Michael McElwain, Qian Gong, Sara Heap, Karl Stapelfeidt, Bruce Woodgate

- GODDARD MISSION SERVICES EVOLUTION CENTER (GMSEC) SECURE APPLICATION PROGRAMMING INTERFACE (API) RELEASE 3.5

  Robert Wiegand, Vuong Ly, Matthew Handy, Joseph Gurganus, David Whitney, Daniel Hunke

- INVESTIGATION OF A GENERIC MULTI-CHANNEL CHARGE SENSITIVE AMPLIFIER FOR GSFC SOLID STATE DETECTOR INSTRUMENTS

  Udayan Mallik, Stanley Hunter, Lavida Cooper

- RESTORE RPO SENSOR COMPLEMENT

  Matthew Strube, Michael Moreau, Bo Naasz

- COMPACT WIDE BANDWIDTH PASSIVE PHASE SHIFTER FOR RADIO FREQUENCY (RF) AND MICROWAVE APPLICATIONS

  Wei-chung Huang

- GNSS EPHEMERIS WITH GRACEFUL DEGRADATION AND MEASUREMENT FUSION

  James Garrison, Michael Walker

- MICRO FLIGHT EXECUTIVE (UFE) SMALL INSTRUMENT PROCESSING FRAMEWORK

  Dwain Molock

- RADIATION HARDENED BY DESIGN MULTI-PATH VARIABLE GAIN DIGITIZER WITH SELECTABLE AUTO-ZERO / CHOPPER STABILIZATION

  Gerard Quilligan, Shahid Aslam

- ADVANCED NUMERICAL INTEGRATION TECHNIQUES FOR HIGH-FIDELITY SDE SPACECRAFT SIMULATION

  Joseph Galante

- LINUX KERNEL DRIVER AND SOFTWARE LIBRARY FOR SPACEWIRE PCI CARD

  Thomas Johnson

- SECOND GENERATION SEARCH AND RESCUE SOFTWARE DEFINED RECEIVER

  Reese Bovard

- GRAVITE INCINERATOR

  Peyush Jain, Richard Ullman, Wayne McCullough, David Trang, Chintu Mistry, Ryan Gerard, Shyam Vyas, Michael Iwunze, Angelo Bertolli

- IMPROVED OPTICAL PLANAR WAVEGUIDE STRUCTURES FOR HIGH-PERFORMANCE LASER TRANSMITTERS

  Mark Stephen, Anthony Yu

- **KA BAND EARTH COVERAGE** ANTENNA FOR NASAS KA-BAND COMMUNICATION APPLICATIONS

  Cornelis Du Toit, Victor Marrero-Fontanez

- NASA SOIL MOISTURE ACTIVE PASSIVE MISSION (SMAP) RADIOMETER INSTRUMENT LEVEL 0-A (L0A) SCIENCE SIGNAL AND DATA PROCESSING SOFTWARE (SPS) FOR INITIAL PRE-PROCESSING OF SMAP SPACECRAFT RADIOMETER TELEMETRY FRAME (TF) FILES (L0A SPS) AND GENERATING FILES FIRST SCAN AND LAST SCAN TIMES IN DIFFERENT TIME FORMATS.

  Semion Kizhner, Matthew Brandt

- SATCAM: REAL-TIME VISUALIZATION OF OPERATIONAL SPACECRAFT BASED ON REAL-TIME TELEMETRY

  Eric Stoneking, Dean Chai, Neerav Shah, Blair Carter

- **G**AME AND REPOSITORY FOR APERTURE SOLUTIONS AND PATTERNS (GRASP)

  Nargess Memarsadeghi, Richard Lyon, Jeffrey Hosler

- CLIENT BERTHING SYSTEM / MECHANISM

  Kelvin Garcia, Thomas Hanyok, Matthew Ashmore

- HYPERSPECTRAL IMAGE PROJECTOR WITH POLARIZATION CAPABILITY

  Teresa Ewing, Steve Serati

- JAMES WEBB SPACE TELESCOPE (JWST) SYSTEM FOR IMAGE DIGITIZATION, ENHANCEMENT, CONTROL AND RETRIEVAL (SIDECAR) APPLICATION SPECIFIC INTEGRATED CIRCUIT (ASIC) FLIGHT ASSEMBLY CODE (FAC) BUILD 7.0

  Donna Wilson, Markus Loose, Matthew Lander

- TEMPERATURE COMPENSATING PMT HOUSING

  Francisco San Sebastian

- VECTOR NETWORK ANALYZER CALIBRATION FOR QUASI-OPTICAL DUAL-PORTS

  David Chuss, Edward Woliack

- FIELDNOTES: A MOBILE APP FOR COLLABORATIVE EXPLORATION

  Carl Hostetter, Troy Ames

- CONSOLIDATED LEARNING ASSESSMENT INTERVIEWER FOR RECOMMENDED EXPERIENCES (CLAIRE)

  Robert Menrad, Sophia Marnell

- SPACECRAFT AND SPACE SYSTEM FUEL-LEAK DETECTION SENSORS

  Edward Sabolsky, Thomas Evans, Jonathon Taub

- THERMAL MICRO-EXTRACTION LABORATORY FOR EXTRACTION OF ORGANIC AND INORGANIC COMPOUNDS FROM MISSIONS TO PLANETS, SATELLITES, AND PRIMITIVE BODIES

  Manuel Balvin, Michael Callahan, Yun Zheng, Ramsey Smith

- A HYBRID LOOP ELEMENT DESIGN FOR ENHANCED HIGH FREQUENCY REFLECTOR/REFLECTARRAY PERFORMANCE

  Thomas Hand, Michael Cooley, David Sall, Gary Kempic

- INTEGRATED SCIENCE INSTRUMENT MODULE (ISIM) HARDWARE MODELS

  Dustin Geletko, Jeffrey Joltes, Steven Seeger, Justin Morris, Scott Zemerick

- MULTIPLE FREQUENCY BAND SOFTWARE-DEFINED RADIOMETER

  Lynn Miles, Damon Bradley, Englin Wong, Edward Kim, Jeffrey Piepmeier, Peter Young

- REMOTELY OPERATED SENSOR PLATFORM FOR SHALLOW WATERS

  Geoffrey Bland, Ted Miles

2013 TECHNOLOGY DISCLOSURES

- METHOD AND APPARATUS FOR MEASUREMENT OF ATMOSPHERIC CARBON MONOXIDE AND METHANE

  Mark Paige, Anthony Gomez, Alan Stanton

- MODULES FOR PROPULSION & DEPLOYMENT ELECTRONICS (PDE) SYSTEM FOR THE LUNAR RECONNAISSANCE ORBITER (LRO) MISSION

  Jason Badgley

- HERMETIC PHOTO TUBE HOUSING

  Francisco San Sebastian

- BI-STATIC ACTIVE MICROWAVE REMOTE SENSING OF REFLECTED SIGNALS-OF-OPPORTUNITY

  Jeffrey Piepmeier, Carey Johnson, Manohar Deshpande

- A 16-BEAM NON-SCANNING SWATH MAPPING LASER ALTIMETER INSTRUMENT

  Anthony Yu, Michael Krainak, David Harding, James Abshire, Xiaoli Sun, Luis Ramos-Izquierdo, John Cavanaugh, Susan Valett, Thomas Winkert, Michael Plants, Cynthia Kirchner, Peter Dogoda, Brian Kamamia, R. Faulkner, Aleander Betin

- LHR-CUBE: A LIMB-VIEWING CUBESAT INSTRUMENT FOR ATMOSPHERIC MEASUREMENTS OF METHANE AND CARBON DIOXIDE - FY13 IRAD

  Emily Wilson, Scott Schaire

- A PARTICLE-FOCUSING INLET TOWARD DEVELOPMENT OF AN IN SITU AEROSOL MASS SPECTROMETER

  Melissa Trainer, Stephanie Getty, Eric Cardiff, Carrie Anderson, William Brinckerhoff

- DESIGN AND FABRICATION OF NANOWIRE DETECTOR PIXELS WITH WAVELENGTH & POLARIZATION DIVERSITY

  John Hagopian, Thomas Stevenson, Shahram Shiri

- GODDARD MISSION SERVICES EVOLUTION CENTER (GMSEC) SECURE APPLICATION PROGRAMMING INTERFACE (API) MODULE VERSION 1.0

  Robert Wiegand, Vuong Ly, Matthew Handy, Thomas Sullivan

- MICRO-SCALE TESTING OF NON-WOVEN CARBON NANOTUBE SHEETS AND YARNS

  Justin Jones, James Magargee, Fabrice Morestin, J. Cao

- EFFICIENT RADIATION SHIELDING THROUGH DIRECT METAL LASER SINTERING

  Jean-Marie Lauenstein, Steven Kenyon, Raymond Ladbury, Michael Xapsos, Jonathan Pellish, Donald Hawkins

- GROUND ARCHITECTURE OPTIMIZATION USING AN ITERATIVE HILL CLIMBING ALGORITHM TO MINIMIZE LATENCY

  George Bussey

- A SIMPLE IMPEDANCE MATCHED PLANAR MICROWAVE BLOCKING FILTER

  Edward Wolack, Kongpop U-yen, David Chuss

- MACHINE VISION BASED POSE ESTIMATION SYSTEM USING ELLIPSE DETECTION FOR SPACECRAFT AR&D

  Marcello Napolitano, Andres Velasquez Escandon

- MINIATURE, RUGGEDIZED OPTICAL ZOOM LENS

  Ross Henry, Jonathan Kraeuter, James Biesinger, Jelila Mohammed

- SIMPLER FRAMEWORK SOFTWARE LIBRARY VERSION 1.0

  Timothy Ray

- INSTRUMENT FOR MEASURING HG AND H2S CONCENTRATIONS IN NATURAL GAS LINES

  Emily Wilson, Richard Kay, Demetrios Poulios

- ROBOTIC GRIPPER FOR AUTONOMOUS RENDEZVOUS AND CAPTURE OF SATELLITES

  Matthew Ashmore

2013 PATENTS

Patents Issued

- PHASE RETRIEVAL FOR RADIO TELESCOPE AND ANTENNA CONTROL

  Bruce Dean

- ADR SALT PILL DESIGN AND CRYSTAL GROWTH PROCESS FOR HYDRATED MAGNETIC SALTS

  Edgar Canavan, Peter Shirron, Michael DiPirro

- PROGRESSIVE BAND SELECTION FOR HYPERSPECTRAL IMAGES

  Kevin Fisher

- AUTOMATIC EXTRACTION OF PLANETARY IMAGE FEATURES

  Jacqueline Le Moigne, Giulia Troglio, Jon Benediktsson, Sebastiano Serpico, Gabriele Moser

- NOVEL SUPERCONDUCTING TRANSITION EDGE SENSOR DESIGN

  John Sadleir

- LOW CONDUCTANCE SILICON MICRO-LEAK FOR MASS SPECTROMETER INLET

  Dan Harpold, Hasso Niemann, Bernard Lynch, Brian Jamieson

- SPACECUBE DEMONSTRATION PLATFORM

  David Petrick, Alessandro Geist, Gary Crum, Manuel Buenfil, Jeffrey Hosler, Tom Flatley, Daniel Espinosa

- A LOW COST, LOW TEMPERATURE RADIOMETER FOR THERMAL MEASUREMENTS

  James Tuttle, Thomas Halt, Michael DiPirro

- REFINEMENT OF THE HSEG ALGORITHM FOR IMPROVED COMPUTATIONAL PROCESSING EFFICIENCY

  James Tilton

- AN INSTRUMENT SUITE FOR THE VERTICAL CHARACTERIZATION OF THE IONOSPHERE-THERMOSPHERE SYSTEM FROM 100KM TO 700KM ALTITUDE

  Federico Herrero, Hollis Jones, Theodore Finne, Andrew Nicholas

- SPECULAR COATINGS FOR COMPOSITE STRUCTURES

  Russell Rowles, Robert Kiwak, James Lohr, Kenneth Segal, Wanda Peters

- OPTIMAL PADDING FOR THE TWO-DIMENSIONAL FAST FOURIER TRANSFORM

  Jeffrey Smith, David Aronstein, Bruce Dean

- NON-PYROTECHNIC ZERO-LEAK NORMALLY-CLOSED VALVE

  Rebecca Gillespie

Provisional Patents Filed

- MASKLESS CREATION OF SMALL STRUCTURE WITH SELECTIVE DEPOSITION OF GOLD NANO-PARTICLES (GOLD BLACK)

  Rainer Fettig, Brook Lakew, John Brasunas

- SOFTWARE SUITE FOR MODELING AND SIMULATION OF SHAPED EXTERNAL OCCULTERS

  Richard Lyon

- ASYMPTOTIC DIET ALGORITHM WITH PSYCHOLOGICAL AND TEMPORAL STABILITY (ADAPTS)

  Steven Curtis

- WALLOPS FLIGHT FACILITY 6U ADVANCED CUBESAT EJECTOR (ACE)

  Luis Santos, John Hudeck

- COMPACT KA BAND ANTENNA FEED WITH DOUBLE CIRCULARLY POLARIZED CAPABILITY FOR NASA'S KA BAND COMMUNICATION APPLICATIONS

  Cornelis Du Toit, Kenneth Hersey

- SPACE PLASMA ALLEVIATION OF REGOLITH CONCENTRATIONS IN LUNAR ENVIRONMENTS BY DISCHARGE (SPARCLED)

  Steven Curtis

- RADIATION HARDENED 10BASE-T ETHERNET PHY

  Michael Lin, Kevin Ballou, Daniel Espinosa, Edward James, Matthew Kliesner, David Petrick

- OPTICAL NULL LENS VERIFICATION USING IMAGE-BASED WAVEFRONT SENSING

  Peter Hill, Patrick Thompson, David Aronstein, Matthew Bolcar, Jeffrey Smith

- SPACECUBE V2.0 PROCESSOR CARD, ENGINEERING MODEL

  David Petrick, Dennis Albaijes

2013 PATENTS

Patent Applications Filed

- WALLOPS FLIGHT FACILITY 6U ADVANCED CUBESAT EJECTOR (ACE)

  Luis Santos, John Hudeck

- IMPEDANCE MATCHED TO VACUUM, INVISIBLE-EDGE DIFFRACTION SUPPRESSED MIRROR

  Shahram Shiri, John Hagopian, Patrick Roman, Edward Wollack

- SPACECUBE DEMONSTRATION PLATFORM

  David Petrick, Alessandro Geist, Gary Crum, Manuel Buenfil, Jeffrey Hosler, Tom Flatley, Daniel Espinosa

- CHEMICAL SENSORS BASED ON 2-DIMENSIONAL MATERIALS

  Mahmooda Sultana

- MIRRORLET ARRAY FOR INTEGRAL FIELD SPECTROMETERS (IFS)

  Qian Gong, Philip Chamberlin, David Content, Jeffrey Kruk

- SPACECUBE V2.0 MICRO

  David Petrick, Alessandro Geist, Michael Lin, Gary Crum

- SOFTWARE SUITE FOR MODELING AND SIMULATION OF SHAPED EXTERNAL OCCULTERS

  Richard Lyon

- SPACECUBE V2.0 FLIGHT PROCESSOR CARD

  David Petrick, Thomas Flatley, Alessandro Geist

- SPACECUBE V. 2.0 FLIGHT POWER CARD

  David Petrick, Pietro Sparacino, Milton Davis

- PROPELLANT TRANSFER ASSEMBLY DESIGN AND DEVELOPMENT

  Brian Nufer, Stephen Anthony, Craig Fortier, Philip Kalmanson

- MUTI-FUNCTION MICROPOSTERS INSIDE OF MICROFLUIDIC CHANNEL FOR LAB-ON-A-CHIP DEVICE

  Yun Zheng

- MISSE-7 CONTROL CENTER

  Jeffrey Hosler, Daniel Espinosa, David Petrick

- SPACECUBE V2.0 PROCESSOR CARD, ENGINEERING MODEL

  David Petrick, Dennis Albaijes

- GREEN PRECISION CLEANING SYSTEM

  Michael Wilks

- BROADBAND PLANAR IMPEDANCE TRANSFORMER

  Negar Ehsan

SPACE ACT AGREEMENTS

COMPANY	PURPOSE
University of Minnesota IRMOS	*Astronomy research instrument*
Boeing Co.	*Conjunction Assessment Risk Analysis (CARA) – On-orbit collision avoidance*
Hollywood Black Film Festival (HBFF)	*Inspired sci-fi film screenplays pertinent to the current and future work of NASA. Also to produce films that would stir more interest in the space program and inspire careers in science, technology, engineering and mathematics (STEM)*
Space Dynamics Laboratory/ Utah State University Research Foundation	*Development of a high-resolution cryogenic rotary encoder*
Rocket21.com	*Education & Public Outreach (EPO) & OPTIMUS PRIME Spinoff Award*
Syneren Technologies Corporation	*Syneren is interested in further testing and developing some of NASA GSFC effective noise reduction and data processingtechnologies*
Johns Hopkins University	*Goddard Space Flight Center and Johns Hopkins University would benefit from the establishment of a formal relationship to educate Program participants about government Technology Transfer practices and resources as well as Goddard's innovative business practices*
Maryland Department of Business and Economic Development	*NASA Goddard Space Flight Center (GSFC) has need of specialized skills and technologies in order to support its numerous mission applications. NASA Goddard Space Flight Center is also committed to promoting the economic welfare of the surrounding Mid-Atlantic Region. As a result, NASA Goddard Space Flight Center desires to engage in technical exchanges with local technology organizations regarding new trends, theories, techniques, and problems in aerospace technology that may be applicable to NASA Goddard Space Flight Center's mission. In addition, the development of local educational and labor resources specific to NASA Goddard Space Flight Center's needs would provide NASA Goddard Space Flight Center with a powerful strategic advantage*

SPACE ACT AGREEMENTS

COMPANY	PURPOSE
Johns Hopkins University	*NASA GSFC and Johns Hopkins wish to produce and test detectors for the Cosmology Large Angular Scale Surveyor (CLASS) instrument*
Department of Defense - SpaceTest Program	*Memorandum of Agreement (MOA) delineates the roles and responsibilities among DoD STP and NASA GSFC on the terms, conditions, and funding for collaboration on the Space Test Program - Houston 4 (STP-H4) payload, in which DoD STP will provide integration and flight of the GSFC International Space Station SpaceCube Experiment 2.0 (ISE 2.0) on STP-H4, and GSFC will provide two (2) flight-qualified units of the SpaceCube Communication Interface Box (SpaceCube CIB) for STP-H4*
Emergent Space Technologies, Inc.	*Emergent and NASA GSFC wish to enter into a fully reimbursable agreement to allow Emergent access and use of the GSFC Formation Flying Test Bed (FFTB) GPS test and simulation equipment and facilities, on a non-competitive and after-hours basis. Emergent currently staffs, maintains and operates the Facility on NASA GSFC's behalf for NASA's space mission support under contract to NASA GSFC. NASA GSFC benefits by maintaining test readiness and operational expertise including personnel, and recovery of facility maintenance costs*
Sigmadyne, Inc.	*The goal of this effort is to develop a manufacturing process for post-polishing an optical surface after figuring the optical surface with a sub-aperture fabrication tool, such as a diamond turning machine*
Northrop Grumman Technical Services, Inc.	*The purpose of this Agreement is to establish the extent of knowledge sharing between NASA Goddard and NGC in developing reaction sphere technology. NGC has successfully demonstrated a reaction sphere prototype and control algorithm with magnetic actuation and has filed for a US Patent for the spherical motor control methodology*
Wisdom Tools	*Aerodynamically Stabilized Instrument Platform for Kites and Tethered Blimps ("AeroPod"), NASA Case No. GSC-15856-1*

6th Annual Sciences & Exploration Directorate New Year's Poster Party

(January 30, 2013, Greenbelt MD)

One of the first events of 2013 was the 6th Annual Sciences & Exploration Directorate (SED) New Year's Poster Party, held January 30 at NASA Goddard Space Flight Center. This event provides an opportunity for Applied Engineering and Technology Directorate (AETD) Earth and space scientists to display posters highlighting meetings they attended in 2012.

The ITPO took advantage of this gathering of NASA Goddard innovators to speak to them about the benefits of technology partnerships. The ITPO also discussed the New Technology Assessment (NTA) system and licensing with attendees.

Innovative Technology Partnerships Office staff member Brady Spenrath speaks with an attendee at the 6th Annual Science & Exploration Directorate New Year's Poster Party. —PHOTO BY NASA

Aerospace@Annapolis Day

(February 1, 2013, Annapolis, MD)

Guests visit the Innovative Technology Partnerships Office exhibit during the 2013 Annual Aerospace@ Annapolis Day. —PHOTO BY NASA

Aerospace @ Annapolis Day is an annual event organized by NASA Goddard to inspire students and educators to pursue and teach science, technology, engineering, and mathematics (STEM) education. The 2013 event, held February 1 at the Miller Senate Office Building in Annapolis, Maryland, attracted approximately 400 attendees, including state lawmakers and midshipmen from the Naval Academy. NASA displayed several exhibits including a full-size model of the Mars Curiosity rover. Other highlighted missions were the Landsat Data Continuity Mission and the Robotic Refueling Mission.

The Innovative Technology Partnerships Office participated in this event, along with Maryland companies (and NASA Goddard Partners) Northrop Grumman, Emergent Space Technologies Inc., DesignAmerica Inc., and the University of Baltimore. These companies demonstrated their technologies and their experiences partnering with NASA Goddard. The event helps raise awareness of NASA Goddard's impact within Maryland and the U.S in general. It also provided an opportunity to discuss how partnerships with companies make positive contributions to NASA's ongoing research & development and enhance the Agency's technology capabilities.

ARPA-E Energy Innovation

(February 26-27, 2013, National Harbor, MD)

Innovative Technology Partnerships Office staff member Eric McGill speaks with a visitor at the 2013 ARPA-E Energy Innovation Summit. —PHOTO BY NASA

The annual ARPA-E Energy Innovation Summit brings together key players from across the “energy ecosystem,” including researchers, entrepreneurs, investors, corporate executives, and government officials. The purpose is to exchange ideas for developing and deploying the next generation of energy technologies. The 2013 meeting was help February 26 and 27 at the Gaylord National Hotel and Convention Center in National Harbor, Maryland.

The ITPO represented NASA Goddard in this year’s meeting, which was also attended by a representative from NASA Glenn Research Center. Many of the meeting’s 2700 attendees (including students) visited NASA’s Technology Showcase exhibit. Visitors asked about NASA technologies in a number of energy-related fields, including electronics, solar energy, biofuel, CPV technology, batteries, and the TechPort system.

2013 Association of University Technology Manager (AUTM) Annual Meeting

(February 27 – March 2, 2013, San Antonio, TX)

The Association of University Technology Managers (AUTM) is a group dedicated to supporting and advancing academic technology transfer globally. Its annual meeting provides a “one-stop” opportunity for industry dealmakers and investors to network with academic research institutions from around the world.

ITPO Chief Nona Cheeks was a guest speaker at the 2013 AUTM Annual Meeting, held February 27 through March 2 in San Antonio, Texas. Ms. Cheeks spoke as part of a panel, sharing her knowledge of technology transfer and commercialization. During the meeting, the ITPO formed business relationships with other technology managers from academia and industry. The ITPO also heard from a variety of experts discussing changing climate of technology transfer. Among the important factors shaping the future of this climate are recent economic issues, shifts in social media, and the effects the America Invents Act on U.S. patent policy.

Mid-Atlantic Advanced SBIR Strategies Workshop

(March 13, 2013, Herndon, VA)

The Mid-Atlantic Advanced SBIR Strategies Workshop presents strategic advice to current and prospective phase I SBIR/STTR award recipients to better position themselves for successful Phase II and Phase III opportunities. The workshop provides attendees the opportunity to hear from industry experts, learn about the new rules in SBIR/STTR, and other related content. The 2013 Workshop was held March 13 in Herndon, Virginia. The SBIR program is also a key vehicle for bringing new technologies into NASA Goddard, while providing small businesses the opportunity to work with the Center.

Former Innovative Technology Partnerships Office SBIR/STTR Program Manager and Technology Infusion Manager Cynthia Firman talks with attendees about SBIR opportunities. —PHOTO BY NASA

The ITPO hosted a booth at the 2013 Workshop. ITPO SBIR/STTR Program Manager and Technology Infusion Manager Cynthia Firman spoke about NASA Goddard’s SBIR Program, and conducted a presentation on SBIR strategies and the writing of competitive SBIR Phase II proposals.

ITPO Visits the University of Baltimore

(April 30, 2013, Baltimore, MD)

ITPO Technology Manager Dennis Small talks with University of Baltimore students about NASA Goddard's technology transfer efforts. —PHOTO BY NASA

Through a partnership between NASA Goddard and the University of Baltimore, the ITPO offers students a choice from several promising NASA Goddard technologies; and the students (operating under a NASA Non-disclosure Agreement) work in teams to conceive new applications for the technologies, and draft business plans based on how they would use the technology. This provides NASA Goddard a new and different perspective on how their technologies can be adapted and applied to non-NASA applications (often resulting in "outside-the-box" ideas and suggestions), while offering students an excellent opportunity to work with cutting-edge technologies that have yet to be commercialized. The students learn valuable lessons about marketing, business model development, and venture capital; while the ITPO utilizes the students' application and marketing ideas when seeking partners and licensees for the technologies.

As part of this program, ITPO Technology Manager Dennis Small and Commercialization Specialist Brady Spenrath visited the University of Baltimore on February 5 to explain the fundamentals of government technology transfer to Dr. Michael Laric's marketing class. Small and Spenrath returned to University of Baltimore on April 30 to listen to the students' impressive final presentations.

Open Source Summit

(June 25-26, 2013, Washington, DC)

The annual Open Source Summit is an annual meeting that brings together members of the Open Source community and user group leadership, project leads, committees, developers, non-profit foundations, and others with a stake in keeping software open. The third annual Open Source Summit was help June 25 and 26 at NYU in Washington, D.C., and was attended by ITPO Technology Manager Enidia Santiago-Arce, Commercialization Specialist Andrei Zorilescu, and Commercialization Specialist Brady Spenrath.

The Summit enables corporations, small businesses, entrepreneurs, and government agencies to learn from seasoned experts, and openly discuss best practices regarding building effective open source communities and improving software or processing data through crowdsourcing.

Society of Manufacturing Engineers Conference

(June 2-4, 2013, Baltimore, MD)

The Society of Manufacturing Engineers (SME) is a nonprofit organization that has been serving practitioners, companies, educators, government, and communities across the manufacturing spectrum for more than 80 years. SME's mission is to advance manufacturing by addressing both

Innovative Technology Partnerships Office staff members Brady Spenrath and Andrei Zorilescu talk with attendees at the 2013 Society of Manufacturing Engineers Annual Conference in Baltimore, Maryland. —PHOTO BY NASA knowledge and skill needs for industry. SME events provide an opportunity for attendees to showcase innovation, share knowledge, grow their businesses, and build relationships.

The SME held its annual conference June 2 through 4 in Baltimore, MD. In attendance were members of the ITPO, who spoke with visitors about topics such as licensing opportunities. The ITPO also provided information on partnering with NASA Goddard. SME members were also given a tour of NASA Goddard facilities and labs; and were treated to talks from NASA Goddard's Center Chief Technologist Peter Hughes and ITPO Senior Technology Manager Darryl Mitchell.

Technology Innovation and Technology Transfer Training

(June 6, 2013, Greenbelt, MD)

A critical first step in the technology transfer process is to record and document each innovation, and enter it into the NASA Goddard New Technology Assessment system. This ensures that a full and up-to-date inventory of NASA Goddard's technology portfolio exists, and that each innovation is properly considered and given the opportunity to be applied to other non-NASA purposes.

On June 6, ITPO staff member Joseph Holmes conducted a training course for NASA Goddard scientists and engineers on how to properly disclose their inventions, and what happens to their technology after the ITPO receives their New Technology Report. Dr. Holmes led the two-hour training session instructing contractors and civil servants both new and experienced. Topics included:

- What constitutes an invention?
- At what point in the development cycle to report a technology?
- The ITPO's process of marketing and commercialization.
- Awards and royalties inventors can earn for reporting.

The course also touched on Intellectual Property (IP) management.

NASA Goddard Innovative Initiatives Speaker Series with Author Jim Carroll

(June 10, 2013, Greenbelt, MD)

The ITPO hosted author and innovation expert Jim Carroll at NASA Goddard on June 10. In attendance were NASA Goddard management, innovators, and program/project managers. Dr. Carroll addressed topics such as how to form strategic collaborations to increase productivity despite diminishing resources.

After the presentation, Dr. Carroll led a discussion on connecting with high-quality collaborative partners through a fast and targeted approach, without compromising agency or center policies, intellectual property assets, or strategic plans. A separate round table discussion highlighted ways to improve information exchange to better capitalize on existing relationships and attract a broader spectrum of scientific partners, technical partners, and projects.

Author and Innovation Expert Jim Carroll, speaks at the ITPO Innovative Initiatives meeting and demonstrates an interactive poll with audience members. —PHOTO BY NASA

The South African Ministry of Science visited Goddard to meet and talk with GSFC Management. —PHOTO BY NASA

South African Dignitaries Visit Goddard

(June 21, 2013, Greenbelt, MD)

On June 21, the South African Ministry of Science and additional dignitaries visited NASA Goddard to speak with management, engineers, and scientists regarding NASA Goddard's Space Directorate.

The delegation toured NASA Goddard facilities, including the VisWall, James Webb Space Telescope, Magnetospheric Multiscale Mission, and Global Precipitation Measurement facilities. Opportunities for a partnership with South Africa and its developing space program are forming.

2013 Goddard Industry Day

(November 2, 2012, Rockville, MD)

Goddard Industry Day is a free event that showcases NASA Goddard technologies available for license, and highlights opportunities for partnership and collaboration with NASA Goddard via Space Act Agreements. Industry Day is designed for the benefit of industry to help produce more advanced and competitive products. The 2013 event was held at NASA Goddard on August 13, with the ITPO among the participants.

This year's Industry Day was designed to support Service-Disabled Veteran-Owned Small Businesses, with a series of networking and matchmaking opportunities to help increase the knowledge base of how to successfully do business with NASA. The conference included a half day of speakers, networking, and matchmaking sessions, with approximately 400 attendees from small businesses, federal organizations, and prime contractors.

ITPO Senior Technology Manager Ted Mecum talks with an attendee at 2013 Goddard Industry Day —PHOTO BY NASA

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