

National Aeronautics and Space Administration



GODDARD'S STRATEGIC PARTNERSHIPS OFFICE

# A SPOTLIGHT ON INNOVATION

2019 ACCOMPLISHMENTS REPORT

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## ABOUT THE COVER

According to the National Park Service, lighthouses serve two main purposes: to guide night-sailing ships into harbor, and to warn vessels of dangerous or difficult-to-navigate terrain. The Strategic Partnerships Office at NASA's Goddard Space Flight Center guides the process of innovation in a similar way, encouraging creativity and serving as a beacon of assistance for innovators and collaborators alike.

Illustration by: Danielle Battle

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# FROM THE CHIEF

As we come to the end of another decade, I'm proud when I look back on 10 years of technology transfer with the Strategic Partnerships Office (SPO). Though SPO has gone through many name changes (at the beginning of the decade, we were known as the Innovative Partnerships Program) our mission has remained largely the same: to transfer Goddard technologies to the public for the benefit of the nation.

Over the years, we've pursued that mission in creative and sometimes unexpected ways. I've come to realize that in technology transfer, the beaten path doesn't always lead to results, and successful technology licensing requires its own kind of innovation.

In 2012, WIRED magazine wrote about our initiative to auction exclusive licenses to Goddard patents. That year,

NASA licensed a lot of seven patents for \$75,000. More recently, SPO leveraged Space Act Agreements with professional athletic associations. In 2019, Goddard hosted a technology workshop for current and retired professional athletes interested in licensing NASA technology to start new careers as entrepreneurs in the tech industry.

These are just a few examples of the more creative avenues we've explored in following our mission. The year 2019 brought many more connections – seven license agreements, 16 partnerships, and funding for 46 small businesses and four universities through the SBIR program. I have no doubt that the next decade will yield even more innovation and ingenuity as we venture to the Moon and onward to Mars.



**Darryl R. Mitchell, Chief**

Strategic Partnerships Office  
NASA's Goddard Space Flight Center

Photo Credit: NASA/Samantha Kilgore

YEAR IN  
OVERVIEW

2019



## MEET THE STRATEGIC PARTNERSHIPS OFFICE

Think of Goddard's Strategic Partnerships Office (SPO) as a circuit – it connects NASA with outside partners to produce electrifying collaborations through tools such as licensing agreements and Space Act Agreements. Staff members at SPO forge relationships and connections that bring projects to life, facilitating progress that wouldn't happen without the contributions of both organizations.

SPO's technology managers guide the process of technology transfer and partnerships by managing Goddard's portfolio of patentable technologies, reaching out to potential licensees and partners, and negotiating the terms of formal agreements that lead to successful results.

The technology liaison specialists at SPO play a supporting role in the office's activities by marketing Goddard's technologies and capabilities and maintaining communication with NASA innovators.

Finally, SPO's SBIR/STTR team manages Goddard's participation in NASA's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. Though the program's name is complicated, the concept is simple – through a competitive selection process, NASA awards funds to domestic small businesses, which then participate in federal research and development to advance promising technologies with commercial potential. SPO's three facets serve one core purpose: to connect Goddard with outside partners to build a better world.



**Darryl R. Mitchell**  
Chief



**Kerry Leonard**  
Deputy Chief



**Eric McGill**  
Tech Manager



**Dennis Small**  
Tech Manager



**Hossin Abdeldayem**  
Tech Manager



**Manohar Deshpande**  
Tech Manager



**Erin Majerowicz**  
Technology Liaison  
Specialist



**Samantha Kilgore**  
Technology Liaison  
Specialist



**Joe Famiglietti**  
Goddard SBIR/STTR  
Co-Lead



**Quenton Bonds**  
Goddard SBIR/STTR  
Co-Lead



# STRATEGIC PARTNERSHIPS OFFICE

The Strategic Partnerships Office (SPO) at NASA's Goddard Space Flight Center had another busy year. The office gained a new chief, launched a new collaboration with professional athletic organizations, unveiled a program to recognize individual technology transfer efforts at Goddard, and secured seven new licensing agreements.

Each year, SPO works hard to fulfill its three core functions, and this year was no different. SPO is responsible for overseeing technology transfer activities at Goddard, taking technologies invented for space exploration and licensing them to domestic companies. Through this process, Goddard's technologies can become available to the public and form the basis of a new business or commercial product. SPO's technology managers work with Goddard inventors, patent attorneys, and external organizations to evaluate new technologies and guide them toward successful commercialization.

SPO signed seven license agreements in 2019, two of them with the New Orleans-based Institute for Local Innovations, which works with young entrepreneurs to start new businesses using NASA technology. SPO also implemented the Master Innovator Program in 2019, awarding 49 innovators with pins that signify their proficiency and level of involvement in technology transfer. Innovators receive recognition for participation in activities such as licensing agreements, patents, and New Technology Reports (NTRs).

In SPO's partnerships function, SPO staff facilitate collaborations between NASA and other groups to accomplish projects of mutual interest. Most often, these partnerships are formalized through Space Act Agreements, which allow both sides of the partnership to agree on specific terms. In 2019, SPO signed a Space Act Agreement with the National Basketball Players Association and built on Space Act Agreements signed in the previous

year to host technology workshops for professional athletes interested in becoming entrepreneurs utilizing NASA technologies.

In SPO's SBIR/STTR function, Goddard is managing 42 companies with SBIR Phase I awards and 4 companies and their university partners with STTR Phase I awards in 2019. By funding small businesses and their university partners, NASA nurtures the acceleration of new technologies that have commercial potential and could benefit NASA. The SBIR/STTR programs fund companies all over the country, making a national impact.

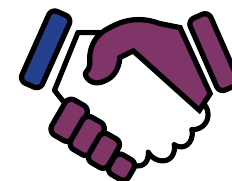
Through these three functions, SPO diversifies and approaches NASA's mission from different angles, maximizing the odds of success and benefit to the American public.

Photo Credit: NASA/ESA

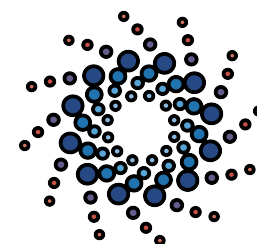
## OUR THREE FUNCTIONS



TECH TRANSFER



PARTNERSHIPS



SBIR/STTR



# 2019 MAGAZINES

## SPINOFFS THROUGH THE DECADES

In 2019, NASA's Goddard Space Flight Center celebrated its 60th anniversary. To reflect on 60 years of innovation, SPO's Winter/Spring issue focused on Goddard spinoffs through the decades. Goddard worked with University of Maryland technical writing students to compile Goddard spinoff stories from the 1970s to the 2000s. From briefcase communicators to life-saving rescue systems, Goddard innovators have produced amazing inventions for space that went on to make a difference in the lives of people on Earth.

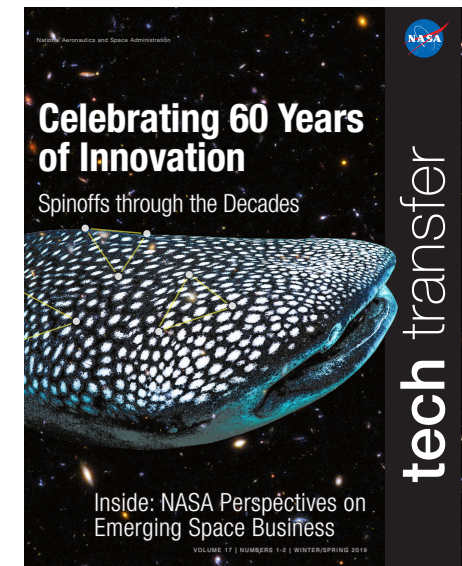
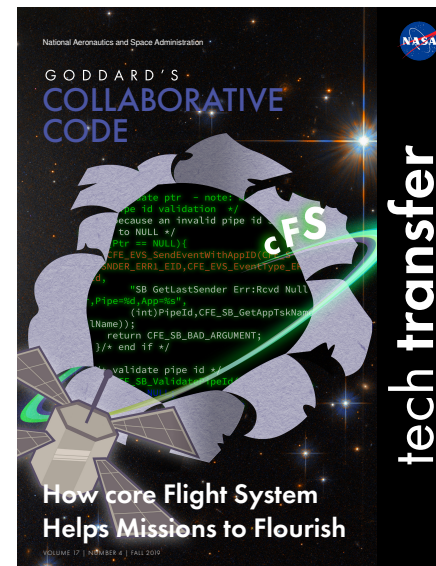
## SMALLSAT REVOLUTION

SPO's Summer issue took a closer look at small satellites, which are tiny satellites often smaller than a microwave oven. These remarkable innovations have changed the game of spaceflight, growing in popularity and functionality since they first emerged as educational tools 20 years ago. Goddard scientists devise new and innovative uses for Small-Sats each year, and throughout the year of 2019, teams worked steadily

on four new CubeSat missions – GTOSat, petitSat, BurstCube, and SNoOPI.

## GODDARD'S STANDOUT FLIGHT SOFTWARE

For the Fall issue, SPO told the story of the core Flight System (cFS), an open source flight software framework developed at Goddard that has taken off in industry and academia. The cFS is a software architecture that saves time and reduces expenses for missions by being reusable from mission to mission. Rather than creating new software for each mission, engineers can use cFS as the base of their flight software, writing mission-specific applications that plug into the existing architecture. The cFS will feature in prominent upcoming NASA missions, including satellite servicing robotic spacecraft Restore-L and space telescope WFIRST. With its open source status, the cFS is available for anyone to download, and more than a few aerospace companies have picked up the software.





# GODDARD TECHNOLOGY WINS NASA'S GOVERNMENT INVENTION OF THE YEAR

NASA's Inventions and Contributions Board (ICB) recognized two Goddard technologies in the 2019 NASA Government Invention of the Year Awards. Both patented technologies have promising applications outside of NASA, in fields as wide-ranging as medicine and agriculture.

A technology developed to study the cosmos called the Miniaturized High-Speed Modulated X-ray Source (MXS) has a diverse array of possible applications stretching far beyond the realm of astrophysics. For the first time in 17 years, Goddard won NASA's Government Invention of the Year award, with MXS receiving the honorable title for 2019.

In another win for Goddard, the Modern Era-Retrospective Analysis for Research and Applications/Analytic Services (MERRA/AS) scored an honorable mention from the ICB. MERRA/AS is the first NASA system to enable near real-time use of petabyte-scale climate data sets. In doing so, MERRA/AS addresses the biggest obstacle to wider use of NASA satellite data and climate model outputs by saving time for the end user.



## MXS

Keith Gendreau, Zaven Arzoumanian, Steven Kenyon, and Nick Salvatore Spartana invented MXS to help us peer into the universe with sharp X-ray eyes. In his role as an astrophysicist, Gendreau envisioned a highly advanced imager that could capture pictures of a black hole's event horizon. The design of this telescope required an X-ray beacon, so Gendreau developed an X-ray source that could vary the intensity of its output rapidly, brightening and dimming at pre-determined intervals. Ultimately, MXS was used for the NICER mission to study neutron stars.

MXS has opened multiple doors at NASA, but the technology has flourished outside of the agency, as well. For example, NASA researchers and partners at Massachusetts General Hospital and the Massachusetts Institute of Technology (MIT) have demonstrated an innovative computed tomography (CT) scanner for medical imaging with MXS. CT systems generate 3D images of internal organs by using X-rays to scan the body in cross sections.

Computer software stitches the cross sections together to create a highly detailed image, used by medical professionals to screen for tumors, analyze bone fractures, search for blood clots in lungs or examine brain injuries.

A MIT-led 2018 paper in the journal *Scientific Reports* describes the novel technology — a portable, no-moving-parts imaging system that offers fine-tuning of the radiation dose received by a patient — and laboratory testing, which generated a detailed 3D image of a pig lung at a quality competitive with current CT scanners. The increased mobility and lower dose of radiation offered by an MXS-based device could result in better and safer access to medical care in rural areas and low-income countries. For future space travel, astronauts could bring a portable CT scanner for medical care on long-distance journeys, such as to Mars.

Under NASA's Space Act Agreement with Massachusetts General Hospital, researchers continue to study the innovation for practical use.



Photo Credit: NASA/Keith Gendreau

## MERRA/AS

Goddard's honorable mention — MERRA/AS — was invented by a collaborative group that includes John Schnase, Daniel Duffy, Glenn Tamkin, Mark McInerney, Denis Nadeau, John Thompson, Scott Sinno, Savannah Strong, and William David Ripley III.

This technology grapples with NASA's immense volumes of climate science data and implements a suite of software innovations collectively referred to as climate analytics-as-a-service. MERRA/AS moves the work of

generating commonly used data analysis products to the server side, resulting in a reduction of time and cost in creating these products.

Scientists who study issues related to past and future states of the climate can find value in this technology, and it can be used for a wide range of climate-related applications, including urban planning, water management, ecological forecasting, natural resource management, disaster planning and relief, and public health.

# NASA SPINOFF COMPANY TESTS WELLNESS APP

Health and fitness have played a role throughout Superbowl champion Obafemi Ayanbadejo's life. After retiring from the NFL, Ayanbadejo graduated with his MBA from Johns Hopkins University and began pursuing a career as an entrepreneur.

In 2018, he worked with the Strategic Partnerships Office to license a patented NASA algorithm with relevance to the health industry, and now, Ayanbadejo is beta testing a new mobile wellness app that seeks to provide highly accurate and detailed metrics on personal health. The app, known as HealthReel, uses the NASA algorithm and a personal smartphone camera to collect data and generate information on an individual's body fat percentage, ideal caloric intake, and approximate risk for health conditions, among other stats.

The NASA algorithm is called "Corrected Body Mass Index (BMI)," and it improves on the traditional BMI formula by taking lean mass into

Photo: Entrepreneur and Superbowl Champion Obafemi Ayanbadejo developed a wellness app called HealthReel, based in part on a NASA algorithm.

account, resulting in a more accurate measure of health. "Corrected BMI" pairs with HealthReel's patented computer vision technology and artificial intelligence algorithms to help users efficiently track progress toward their fitness and health goals.

As the founder and CEO of HealthReel, Ayanbadejo says that current methods for measuring and tracking body fat percentage require people to visit specialized facilities and pay hundreds of dollars for an evaluation. HealthReel's assessment can be done in the user's home and takes a few minutes to complete, Ayanbadejo says.

Once the beta test is complete, Ayanbadejo plans to release the app for download from online app stores.

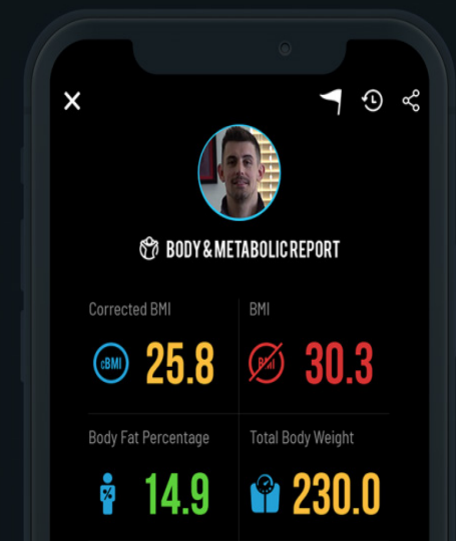
For more information, visit <https://healthreel.com>.



Courtesy of Obafemi Ayanbadejo

## Body & Metabolic Report

Review your body composition and metabolic information.





S P O  
PARTNERSHIPS



# SPACE ACT AGREEMENTS

The Strategic Partnerships Office (SPO) connects the Goddard community to organizations outside of NASA through Space Act Agreements. These versatile, unique-to-NASA legal documents open doors to all kinds of partnerships and collaborations. Using Space Act Agreements, NASA can participate in specific projects and allocate resources, such as personnel, funding, services, equipment, expertise, information, or facilities.

This year, SPO helped facilitate Space Act Agreements with groups of varied backgrounds, from the National Science Foundation to the Maryland Technology Development Corporation. We've highlighted a handful of Space Act Agreements in this report to further illustrate the different types of projects made possible through Space Act Agreements—see below for more.

Photo Credit: NASA/Taylor Mickal

Photo: Caption: Athletes and staff with the National Basketball Players Association visited NASA's Goddard Space Flight Center in July.

## BALL AEROSPACE AND TECHNOLOGY CORPORATION

Partnership Title: High Accuracy, Cryogenic, Refractive Index Measurements

## DEFENSE SPECIAL MISSILE AND AEROSPACE CENTER

Partnership Title: Personnel Access and Expertise Sharing

## DIGITALGLOBE, INC.

Partnership Title: Conjunction Assessment Screening Services

## FERMI NATIONAL ACCELERATOR LABORATORY

Partnership Title: Total Ionizing Dose of Scintillator Devices

## JOHNS HOPKINS UNIVERSITY

Partnership Title: Fabricating Cryogenic Detectors for Cosmic Microwave Background Instrument

## LAWRENCE LIVERMORE NATIONAL SECURITY, LLC

Partnership Title: Space-Based Measurements for Applied and General Research in Earth Science

## LOUDON COUNTY PUBLIC SCHOOLS

Partnership Title: STEM Girl's Night In

## MARYLAND TECHNOLOGY DEVELOPMENT CORPORATION

Partnership Title: Support in Identifying and Establishing Technology Transfer Opportunities and Collaborations

### NATIONAL BASKETBALL PLAYERS ASSOCIATION

Partnership Title: Collaboration on Awareness of NASA Technologies for Entrepreneurial Opportunities

### NATIONAL SCIENCE FOUNDATION

Partnership Title: MOA between NASA and the National Science Foundation for Spacecraft Tracking and Data Acquisition at McMurdo Ground Station

### OFFICE OF NAVAL RESEARCH

Partnership Title: Developing a Compact Submillimeter Polarimetric Radiometer for CubeSat Cloud Ice Observations

### PRINCE GEORGE'S COUNTY PUBLIC SCHOOLS

Partnership Title: STEM Boy's Night In

### SPACE TELESCOPE SCIENCE INSTITUTE

Partnership Title: Loan of Touch Screen System for Display of Science Information

### THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

Partnership Title: Development of Teaching Activities

### UNITED STATES MISSILE DEFENSE AGENCY

Partnership Title: Rotations with Industry and Government Laboratories Program

### WILLIAMSBURG-JAMES CITY COUNTY PUBLIC SCHOOLS

Partnership Title: STEM Girls Night In



**ST&I** | SPACE TELESCOPE  
SCIENCE INSTITUTE

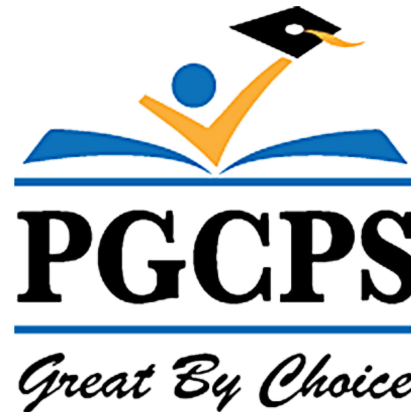






Photo Credit: NASA/Taylor Mickal

## PROFESSIONAL ATHLETES TACKLE TECH TRANSFER AT GODDARD

The year 2019 brought about the first NASA Commercialization Training Camp, a workshop held from June 24-26 for current and retired professional athletes looking to start a company or boost their current business with NASA technology. This workshop marked the beginning of NASA's ongoing collaborations with professional athletes, facilitated through Space Act Agreements with the NFL Players Association, the National Basketball Retired Players Association, the National Basketball Players Association, and the Women's National Basketball Players Association.





Photo Credit: NASA/Taylor Mickal



Photo Credit: NASA/Samantha Kilgore



Photo Credit: NASA/Taylor Mickal

Professional athletes retire at a relatively young age and possess a robust network of connections, making them uniquely positioned to become entrepreneurs in technology-related industries. NASA has an extensive patent portfolio and software catalog with hundreds of technologies available for licensing by the private sector. By helping to coordinate informational workshops, SPO aims to widen the reach of NASA technologies through commercialization.

The three-day workshop in June introduced participants to SPO's team of technology transfer professionals, who work hand in hand with the engineers and scientists at Goddard who invent groundbreaking technologies. The second day featured speakers from the Maryland Technology Development Corporation (TEDCO), which seeks to "provide resources and connections that early stage technology and life sciences companies need to thrive" in the state of Maryland, according to TEDCO's website. Attendees also heard a presentation from Dr. Jim Liew, an assistant professor at Johns Hopkins Carey Business School, with a primer on entrepreneurial finance. In July, Goddard hosted NBA athletes

Photo: Top left, entrepreneur Femi Ayanbadejo spoke to members of the National Basketball Players Association, NFL Players Association, and the National Basketball Retired Players Association in June and July. Right, members of SPO met with attendees of the NASA Commercialization Training Camp in June.

with the National Basketball Players Association (NBPA) visited NASA's Goddard Space Flight Center in Greenbelt, Maryland to learn about NASA's technology transfer and commercialization opportunities.

The meeting provided a glimpse at the NASA Technology Transfer Program and how athletes can become entrepreneurs in the tech industry, introducing athletes to NASA technologies and how to license those technologies as the basis for a new business.

With two successful events completed, SPO plans to coordinate more workshops and events in the coming year.



Photo Credit: NASA/Samantha Kilgore





## STEM NIGHT

In the fall of 2018, 40 high school girls spent the night at Goddard Space Flight Center in Greenbelt, Maryland and learned about science, technology, engineering, and math (STEM) from members of the Goddard community. The event, called "STEM Girl's Night In," was deemed such a success that a similar event took place in spring of 2019 called "STEM Boy's Night In." The Strategic Partnerships Office helped facilitate these events by forming Space Act Agreements with public school districts in Virginia and Maryland.

The Goddard partnerships involved three school districts: Loudon County Public Schools, Prince George's County Public Schools, and Williamsburg-James City County Public Schools. Under the terms of the agreements, Goddard





hosted girls and boys who “are currently not engaged in or have disengaged in STEM academic studies.” By focusing on students who might otherwise be left out of STEM engagement opportunities, the agreements provided support and inspiration in the form of onsite NASA STEM activities, including tours of Goddard’s facilities and hands-on exercises such as a Mars rover competition. Furthermore, the events introduced students to STEM mentors from Goddard.

These events show how Goddard can leverage Space Act Agreements to further a broad swathe of NASA goals, from addressing national challenges and catalyzing economic growth to inspiring and engaging the public in aeronautics, space, and science.



# NOS<sup>3</sup> GODDARD SMALL SATELLITE SOFTWARE WINS RUNNER UP IN NASA 2019 SOFTWARE OF THE YEAR

A small satellite celebrated across the state of West Virginia made it to space at the tail-end of 2018, in part thanks to a handy software program called the NASA Operational Simulator for Small Satellites (NOS<sup>3</sup>).

STF-1 is West Virginia's first spacecraft, created through a collaboration between NASA's Katherine Johnson Independent Verification and Validation Facility (IV&V) and West Virginia University (WVU), among other collaborators. The 3U CubeSat is flying four science experiments from WVU, but its key objective is to demonstrate the use of NOS<sup>3</sup>.

With NOS<sup>3</sup> demonstrating its worth throughout the mission life cycle of STF-1, the software will support future Goddard CubeSat missions, including GTOSat, petitSat, and BurstCube. The Goddard SmallSat community has praised the software's effectiveness in reducing programmatic and technical risk, which boosts the likelihood of mission success. A closer look at NOS<sup>3</sup> shows why this standout software won runner-up in the 2019 NASA Software of the Year competition.

Software developers at IV&V designed NOS<sup>3</sup> specifically to serve small satellite missions, which have specific requirements that differ from larger missions. This customized ability has made NOS<sup>3</sup>

a valuable asset at Goddard, but also outside of NASA, with users including the National Science Foundation Center for Space, High Performance, and Resilient Computing, the Air Force Institute of Technology, and the MIT Lincoln Laboratory.

NOS<sup>3</sup> brings several compelling advantages to SmallSat missions. It lessens cost, reduces risk, and allows missions to focus on accomplishing science objectives. CubeSat missions tend to move at a fast pace, meaning that progress will advance more quickly if multiple stages of the mission can happen in parallel. NOS<sup>3</sup> is able to emulate flight hardware, allowing a software-only test environment early in the mission's development and testing phases. Developers don't have to wait for physical hardware to be in place and can perform coding, instrument integration, and software testing while hardware is being acquired.

NOS<sup>3</sup> is also customizable. Though it was developed for the STF-1 mission, NOS<sup>3</sup> can adapt to other SmallSat missions, and the software package includes information on how to add simulators for hardware that is specific to a particular SmallSat. Since the simulations require no hardware at all, developers can run tests and play out scenarios that would otherwise be impossible to accomplish on the hardware itself. For STF-1, the team could run programs that simulated hardware failures to see what would happen to the entire system in the event of a malfunction.

As a NASA software, NOS<sup>3</sup> integrates seamlessly with Goddard's core Flight System (cFS) and other software programs designed for spacecraft systems, including Goddard-developed 42. This compatibility with cFS – a software adopted by many missions and used at seven NASA centers – adds yet another layer of efficiency to NOS<sup>3</sup>.

The team behind NOS<sup>3</sup> has made the software package open source, meaning anyone can download the code and use it on their own project. By making NOS<sup>3</sup> free and accessible, Goddard's software engineers seek to support other members of the SmallSat community.

NOS<sup>3</sup> is available as one among hundreds of software packages compiled in the online NASA Software Catalog. Those interested in downloading NOS<sup>3</sup> can visit <https://invention.nasa.gov> and search for "NASA Operational Simulator for Small Satellites." The software package can be downloaded directly from NASA's GitHub page at <https://github.com/nasa/nos3>.







Photo Credit: NASA / Samantha Kilgore

Future entrepreneurs visited NASA's Goddard Space Flight Center June 18-19 as part of the 2019 OPTIMUS PRIME Spinoff Promotion and Research Challenge. This annual challenge, run by the Strategic Partnerships Office, encourages students to create their own "spinoff" by taking a NASA technology and inventing a commercial use for it. The winners of the 2019 challenge spent two days touring the Goddard campus and seeing behind-the-scenes laboratories and facilities, including the Mid-Atlantic Noble Gas Research Laboratory, or MNGRL, where researchers analyze samples of rocks from the Moon. Students also met with Peter Cullen, the voice of OPTIMUS PRIME, and during a series of roundtable sessions, he answered their questions about his work as a voice actor and NASA advocate.

OPTIMUS PRIME



Photo Credit: NASA / Samantha Kilgore

After a day and a half of tours, the students attended a winner's ceremony that brought together many of OPSPARC's collaborators, including Mad Science, Hasbro, PRIVO, Adobe, and the National Institute for Aerospace. Speakers included Gihan Amarasiriwardena, the founder of NASA spinoff company Ministry of Supply, and Ben Forta, Adobe's senior director of education initiatives. Students presented their projects and explained their spinoff ideas, which included dishes that clean themselves and a prototype for a 3D bioprinter.

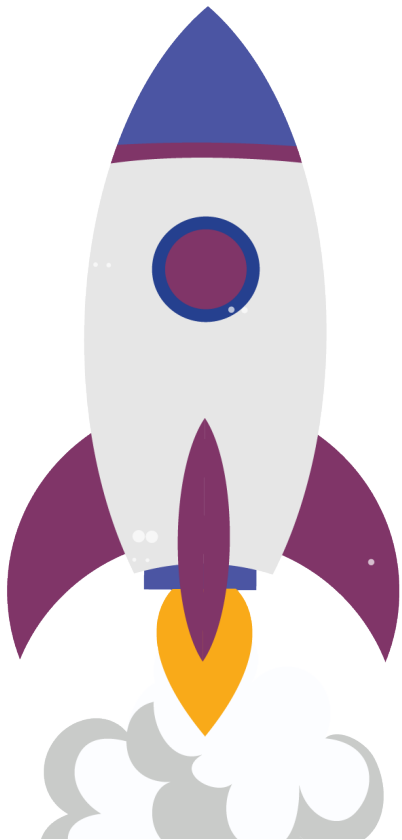


Photo Credit: NASA / Samantha Kilgore



# CONNECTING WITH GODDARD'S COMMUNITY

SPO works with scientists and engineers at Goddard to identify NASA technologies with commercial potential. Each year, the office develops new and creative ways to communicate with innovators and recognize them for their involvement in the technology transfer process. Here's what SPO explored in 2019.



## INNOVATOR TRAINING

SPO updated its internal training for Goddard employees who are interested in learning about SPO's three functions: technology transfer, partnerships, and SBIR/STTR. Called "Countdown to Commercialization," the training walks through the steps a technology takes on its path to becoming a commercial product, from patenting to licensing. The training also includes a section on SBIR/STTR and "Countdown to Collaboration," which focuses on Space Act Agreements and Cooperative Research and Development Agreements.



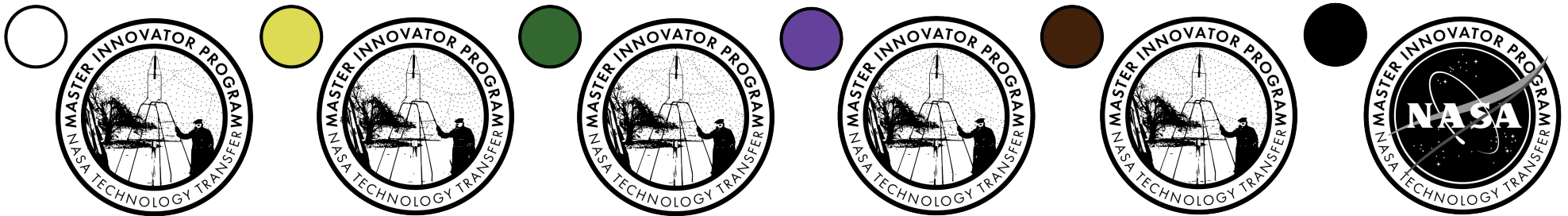
## POSTER CAMPAIGNS

A volley of seasonal NTR posters appeared across the Goddard campus in 2019, with spooky themes any fantasy book lover should recognize. Featuring fun and collectable artwork, the posters aim to remind innovators to report their new technologies to SPO.



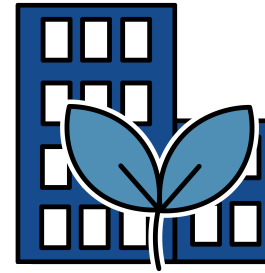
## MASTER INNOVATOR PROGRAM

SPO fully unveiled the Master Innovator Program, a way to recognize innovative achievements stemming from the Goddard community. The Master Innovator Program awards Goddard innovators “belt levels” based on individual contributions to technology transfer. Innovators can qualify for belt level status based on the number of NTRs they have submitted, partnerships they have fostered, patented technologies they have to their name, and additional criteria. Upon reaching the highest “black belt” level, innovators are viewed as subject matter experts and can inform strategic planning of Goddard’s technology transfer and partnering activities. This year, 49 Goddard innovators joined the ranks of the Master Innovator Program.





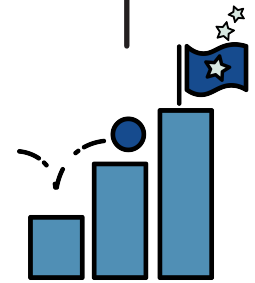
# MARKETING ACTIVITIES



## INTELLIGENT COMMUNITY FORUM GLOBAL SUMMIT 2019

June 11, 2019

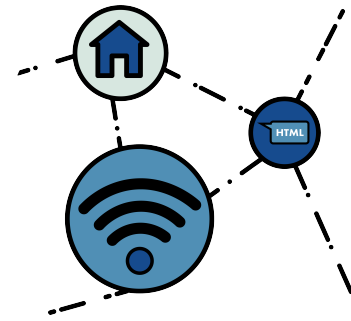
A SPO representative gave a presentation at the Intelligent Community Forum Global Summit 2019 in New York City, New York. The summit brought together urban planning and economic development professionals to discuss technologies that can build strong, sustainable, and intelligent communities within urban settings. The representative shared information about technology transfer at NASA and Goddard specifically, highlighting a handful of patented NASA technologies that could be licensed and applied toward the development of “smart city” products.



## 2019 CONRAD CHALLENGE

April 23-26, 2019

SPO participated in the 2019 Conrad Challenge at NASA’s Kennedy Space Center. The challenge brought together hundreds of student teams from around the world to solve real-world problems using science- and technology-based solutions. SPO and the Conrad Foundation worked through a Space Act Agreement to support young entrepreneurs in applying NASA technologies to their product ideas. Two of the winning teams used NASA technologies for their business pitches. SPO also judged submissions, mentored participants in further developing their pitches using NASA technology, and brought an exhibit displaying information on various technology transfer opportunities.



## SPIE DEFENSE AND COMMERCIAL SENSING CONFERENCE

April 18, 2019

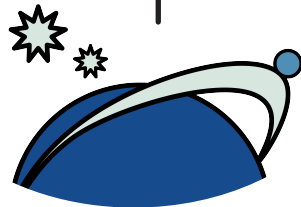
A SPO representative spoke at the International Society for Optics and Photonics (SPIE) Defense and Commercial Sensing Conference in Baltimore, Maryland. The representative shared information about Goddard technology transfer and presenting a review of sensor technology development at Goddard pertaining to Earth science. The review included several specific Goddard technologies available for licensing.



## GODDARD SCIENCES AND EXPLORATION DIRECTORATE POSTER PARTY

Feb. 26, 2019

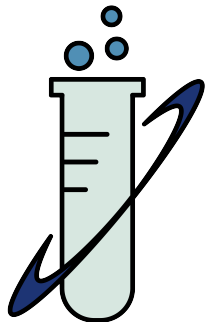
The Strategic Partnerships Office (SPO) participated in the 12th Annual Sciences and Exploration Directorate Poster Party at Goddard’s main campus, bringing an exhibit on technology transfer and speaking to innovators about submitting new technology reports. The event gave innovators an opportunity to showcase their scientific work from the past year through displaying scientific posters. Goddard technology managers connected directly with innovators by talking to them about their posters and explored the potential for new technology reporting as a result of their work.



## 57TH ANNUAL GODDARD MEMORIAL SYMPOSIUM

March 19-21, 2019

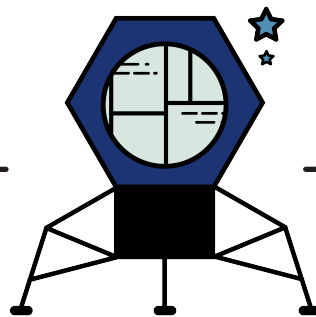
SPO attended the 57th Annual Goddard Memorial Symposium in Silver Spring, Maryland. The symposium is sponsored by the American Astronautical Society, and it brings together professionals across a range of sectors, from government officials and legislators to representatives of private industry and academia.



#### GODDARD SCIENCE JAMBOREE

July 11, 2019

SPO participated in the annual Science Jamboree. Hosted by the Goddard Sciences and Exploration Directorate, the Science Jamboree gives an opportunity for Goddard scientists to share information and updates on their work in an informal setting. SPO had a table at the event and spoke to innovators, handed out inventor notebooks and raised awareness of new technology reporting.



#### APOLLO 11 CELEBRATION

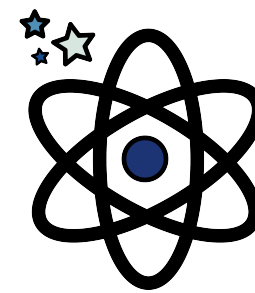
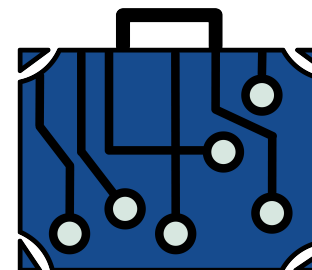
July 18, 2019

Representatives with SPO traveled to Boston and Washington, DC to partake in an Apollo 11 celebration hosted by Ministry of Supply, a NASA spinoff company that produces clothing with NASA technology. The representatives gave speeches that reflected on NASA spinoffs resulting from the Apollo 11 program, as well as looked forward to "spinoffs of the future" that will come from the Artemis program.

#### AMERICA'S VENTURE "CAPITOL" KICKOFF

July 18, 2019

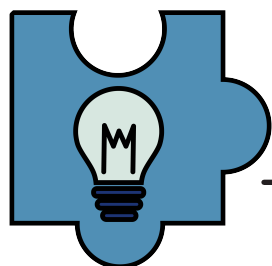
Three SPO representatives attended America's Venture "Capitol" Kickoff Conference at American University in Washington, DC. The representatives spoke with entrepreneurs, venture capital firms, and startups in attendance. Additionally, a SPO representative gave a presentation on technology transfer and commercialization at Goddard.



#### OPTICS WEBINAR

Sept. 18, 2019

SPO worked with Tech Briefs to host an optics webinar. The webinar featured Goddard innovator Mark Stephen, who spoke about advances in photonics for space and commercial applications. Specifically, he highlighted NASA's work with photonic integrated circuits, which enable critical improvements to microprocessors, communication buses, science instrument optical systems, and other technologies. The webinar is available for download online until September 2020: <https://www.techbriefs.com/tb/webcasts/on-demand-webinars>



#### NCSL LEGISLATIVE SUMMIT

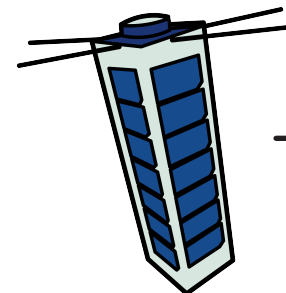
Aug. 5-8, 2019

Three representatives with SPO participated in the National Conference of State Legislatures (NCSL) Legislative Summit in Nashville, Tennessee. NCSL supports the interests of state legislators by providing them with information and resources to solve problems in their states. The representatives brought informational materials on Goddard technology transfer opportunities and displayed a touch screen with NASA Home and City available for legislators to explore. SPO also played a video about Goddard spinoffs from past decades in celebration of Goddard's 60th anniversary.

#### SMALL SATELLITE CONFERENCE

Aug. 3-8, 2019

Four SPO representatives participated in the 33rd Annual Small Satellite Conference in Logan, Utah. Representatives spoke with attendees of the conference at a booth and provided information on licensable Goddard technologies related to small satellites. They networked with members of the small satellite community and answered questions about how working with Goddard could benefit them. Additionally, two technology managers gave presentations to attendees about doing business with Goddard and about a patented SmallSat technology available for licensing.





# 2019 GODDARD PATENTS

## **LASER BEAM EXPANDER WITH ADJUSTABLE COLLIMATION**

Luis A. Ramos-Izquierdo, Xiaoli Sun  
U.S. Patent Number: 10,095,041

## **SYSTEM AND METHOD OF OPTICAL AXIS ALIGNMENT MONITOR AND FEEDBACK CONTROL FOR A SPECTROMETER**

Catherine Marx, Irving Linares, Peter Shu, James Smith  
U.S. Patent Number: 10,113,908

## **HIGH OUTPUT MAXIMUM EFFICIENCY RESONATOR**

Paul R. Stysley, Donald B. Coyle  
U.S. Patent Number: 10,141,705

## **CRYOGENIC HYDROGEN RADIATION SHIELD FOR HUMAN SPACEFLIGHT**

Xiaoyi Li, Shouvanik Mustafi, Alvin J. Boutte  
U.S. Patent Number: 10,144,535

## **ACTIVE GAS-GAP HEAT SWITCH WITH FAST THERMAL RESPONSE**

Peter J. Shirron, Mark O. Kimball  
U.S. Patent Number: 10,145,602

## **PLANAR VIA-LESS CROSSOVER HAVING COPLANAR WAVEGUIDE CONFIGURATIONS AND STUB LAYERS**

Kongpop U-Yen, Edward J. Wollack, Marc Castro  
U.S. Patent Number: 10,147,992

## **CONTINUOUS CARRIER OPTICAL PHASE OPTOMETRIC MEASUREMENT OVER COHERENT OPTICAL COMMUNICATION LINK**

Guangning Yang, Jeffrey R. Chen  
U.S. Patent Number: 10,148,352

## **GATED CDS INTEGRATOR**

Gerard T. Quilligan, Shahid Aslam  
U.S. Patent Number: 10,158,335

## **METHOD OF USING POWER GRID AS LARGE ANTENNA FOR GEOPHYSICAL IMAGING**

Antti A. Pulkkinen, Todd M. Bonalsky, Troy Ames, Carl F. Hostetter  
U.S. Patent Number: 10,175,273

## **NANOSTRUCTURED VANADIUM OXIDE UNCOOLED BOLOMETERS AND METHOD OF FABRICATION**

Ari D. Brown, Emily M. Barrentine, Shahid Aslam  
U.S. Patent Number: 10,184,839

## **INTEGRATED CIRCUIT (IC) CHIP WITH A SELF-CONTAINED FLUID SENSOR AND METHOD OF MAKING THE CHIP**

George Manos, Manuel A. Balvin, Michael P. Callahan  
U.S. Patent Number: 10,189,700

## **METHOD FOR THE ABSOLUTE CALIBRATION OF THE LOCATION AND ORIENTATION OF LARGE-FORMAT DETECTORS USING LASER RADAR**

Phillip Coulter, Raymond Ohl, Timothy Madison  
U.S. Patent Number: 10,191,163  
**STEERING MIRROR ASSIST FOR LASER POINTING**  
Guangning Yang, Jeffrey R. Chen  
U.S. Patent Number: 10,228,465

## **LENSLET ARRAY BASED INTEGRAL FIELD**

## **SPECTROGRAPH AND DATA PROCESSING**

Qian Gong, David A. Content, Michael W. McElwain, Avram Max Mandell, Tyler D. Groff, Maxime J. Rizzo  
U.S. Patent Number: 10,236,166

## **TWO-WAY MICROWAVE POWER DIVIDER**

Kongpop U-Yen, Nathan Kovarik  
U.S. Patent Number: 10,243,250

## **METHOD FOR FORMING COMPONENT-LEVEL RADIATION SHIELD OPTIMIZED FOR ENVIRONMENTAL RADIATION CHARACTERISTICS AND DESIGN CRITERIA**

Jean-Marie Lauenstein, Steven J. Kenyon, Raymond L. Ladbury, Thomas Jordan  
U.S. Patent Number: 10,255,382

## **BI-STABLE PIN ACTUATOR**

Joseph C. Church  
U.S. Patent Number: 10,297,376

## **INDUCTIVE POWER TRANSFER FOR AEROSPACE FLIGHT SYSTEMS**

Michael R. Wright  
U.S. Patent Number: 10,298,060

## **COMPACT, HIGH RESOLUTION THERMAL INFRARED IMAGER**

Murzban D. Jhabvala, Donald E. Jennings, Compton J. Tucker  
U.S. Patent Number: 10,306,155

## **FREQUENCY DIVERSITY PULSE PAIR DETERMINATION FOR MITIGATION OF RADAR RANGE-DOPPLER AMBIGUITY**

Lihua Li, Matthew McLinden, Michael Coon, Gerald Heymsfield, Vijay Subbaraman Venkatesh  
U.S. Patent Number: 10,317,521

### LIDAR INSTRUMENT AND METHOD OF OPERATION

Branimir Blagojevic, Melissa Trainer, Alexander Pavlov  
U.S. Patent Number: 10,337,996

### SYSTEM AND METHOD FOR PROVIDING A MODERN-ERA RETROSPECTIVE ANALYSIS FOR RESEARCH AND APPLICATIONS (MERRA) DATA ANALYTIC SERVICE

John L. Schnase, Daniel Q. Duffy, Glenn S. Tamkin, Mark McInerney, Denis Nadeau, John H. Thompson, Scott Sinno, Savannah L. Strong  
U.S. Patent Number: 10,339,114

### LOW PROFILE WIFI ANTENNA WITH A TOROIDAL PATTERN

Victor J. Marrero-Fontanez  
U.S. Patent Number: 10,340,585

### TUNABLE LASER SYSTEM AND METHOD BASED ON DUAL SIDEBAND LOCKING

Kenji Numata, Haris Riris, Stewart T. Wu  
U.S. Patent Number: 10,348,052

### ANTENNA FOR CUBESAT PLATFORMS

Manohar Deshpande  
U.S. Patent Number: 10,361,472

### APPARATUS FOR ALIGNING AND CONNECTING SIGNAL CONNECTORS ON TWO DIFFERENT BODIES

Richard Michael, Thomas J. Hanyok, Beth A. Keer  
U.S. Patent Number: 10,370,127

### KA-BAND MODULATOR AND TRANSMITTER

Wei-Chung Huang, Jeffrey M. Jaso  
U.S. Patent Number: 10,374,852

### DUAL I2C AND SPI SLAVE FOR FPGA AND ASIC IMPLEMENTATION

George Suarez, Jeffrey J. Dumonthier, George E. Winkert  
U.S. Patent Number: 10,380,061

### MODIFICATION OF PIGMENTS USING ATOMIC LAYER DEPOSITION (ALD) IN VARYING ELECTRICAL RESISTIVITY

Vivek H. Dwivedi, Mark H. Hasegawa  
U.S. Patent Number: 10,392,263

### MULTIPLEXING X-RAY FLUORESCENCE SYSTEM AND METHOD

Keith C. Gendreau, Zaven Arzoumanian, Robert G. Baker, Norman Dobson, Richard Koenecke  
U.S. Patent Number: 10,393,682

### ROBOTIC GRIPPER FOR AUTONOMOUS RENDEZVOUS AND CAPTURE OF SATELLITES

Matthew S. Ashmore  
U.S. Patent Number: 10,414,053

Photo Credit: NASA/The Hubble Heritage Team

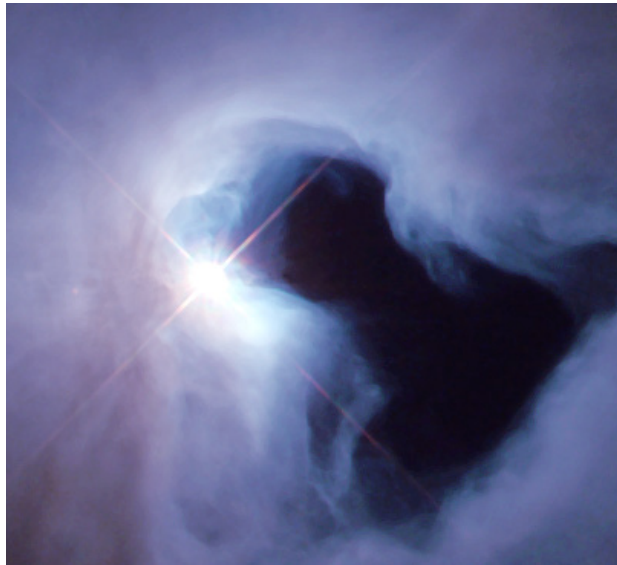


Photo Credit: NASA/ESA, P. Erwin



Photo Credit: NASA/ESA, J. Dalcanton, B.F. Williams, and M. Durbin



# S B I R / S T T R P H A S E I A W A R D S

## HELIOSPACE CORPORATION

Berkeley, California  
Development of Helical Boom Manufacturing

## APPLIED MATERIAL SYSTEMS ENGINEERING, INC.

Schaumburg, Illinois  
Advanced Plasma Sprayed Conductive Thermal Control Material Systems for Improved Performance

## LIGHTSPIN TECHNOLOGIES, INC.

Endicott, New York  
Ultraviolet and Solar Blind Single Photon Diode Arrays

## MICROXACT, INC.

Radford, Virginia  
Wide Energy Range X-ray Neutral Density Filters

## ASTROBOTIC TECHNOLOGY, INC.

Pittsburgh, Pennsylvania  
Ultra Low SWaP Relative Navigation

## COOLCAD ELECTRONICS, LLC

Takoma Park, Maryland  
High Temperature CMOS Control and Power Converter Electronics

## KRAENION

Los Gatos, California  
Machine Learning for Earth Science

## LONGWAVE PHOTONICS, LLC

Mountain View, California  
Laser Sources for Frequency Calibration of Far-Infrared Spectrometers

## DORNERWORKS, LTD.

Grand Rapids, Michigan  
Xen Project Hypervisor for the High Performance Space Computing Platform

## SILICON SPACE TECHNOLOGY CORPORATION

Austin, Texas  
Radiation-Hardened Latch-Up Monitor IC

## SPACE HAZARDS APPLICATIONS, LLC

Golden, Colorado  
A Tool for Defining Solar Particle Access to the Magnetosphere for Satellite Anomaly Attribution

## SCIGLOB INSTRUMENTS AND SERVICES, LLC

Ellicott City, Maryland  
Advanced Hyperspectral Remote Sensing Radiometer for Trace Gas and Aerosol Observations

## DIGITAL OPTICS TECHNOLOGIES, INC.

Rolling Meadows, Illinois  
Compact and Highly Sensitive Multi-Axes Gyroscope Using Large Momentum Transfer Point Source Atom Interferometry

## INNOFLIGHT, INC.

San Diego, California  
Balloon SATCOM

## WARWICK MACHINE & TOOL COMPANY, INC.

Landisville, Pennsylvania  
Water Azeotrope Working Fluids for Advanced Spacecraft Thermal Management

## XANALYTIX SYSTEMS

Clarence Center, New York  
Error-Frame Representation for Spacecraft Visual Relative Navigation

## ADVANCED SPACE, LLC

Boulder, Colorado  
Neural Net Control for Electric Propulsion in 3-Body Orbits

## GEOVISUAL TECHNOLOGIES, INC.

Westminster, Colorado  
Multi-Resolution Deep Learning for Land Use Applications

## SYNAPTICAD SALES, INC.

Blacksburg, Virginia  
Collaborative Multi-Fidelity Modeling and Architecture for Complex Systems Engineering

## EMERGENT SPACE TECHNOLOGIES, LLC

Laurel, Maryland  
Processor Redundancy Enabled Software Event Recovery with Voting

## LITESPAR, INC.

Tucson, Arizona  
MOPA Laser Transmitter with Passive Q-Switch for Space Lidar

## CREATE, LLC

Hanover, New Hampshire  
High-Performance Recuperator for Low-Temperature Turbo-Brayton Cryocoolers

## OPTIMAX SYSTEMS, INC.

Ontario, New York  
Mitigation of Mid-Spatial Frequency Errors

## NALU SCIENTIFIC, LLC

Honolulu, Hawaii  
SWELL: Single-Photon-Sensitive Waveform Enhanced and Lightweight Lidar

**OPTIPRO SYSTEMS, LLC**

Ontario, New York  
Chromatic Interferometric Probe

**IMPOSSIBLE SENSING, LLC**

St. Louis, Missouri  
High Access Raman Probe with Onboard Optical Numerization

**OPTIPRO SYSTEMS, LLC**

Ontario, New York  
Advanced Nanometer Coordinate Measuring Machine

**QUEST THERMAL GROUP**

Arvada, Colorado  
Light Weight Dewar: Low Mass High Performance IMLI/Dewar for Cryogenic Balloon Instruments

**PREDICTIVE SCIENCE, INC.**

San Diego, California  
An Extensible Tool for Estimating Space Weather Benchmarks

**Q-PEAK, INC.**

Bedford, Massachusetts  
Deep UV Laser for Lunar Exploration

**STABLE LASER SYSTEMS, INC.**

Boulder, Colorado  
Rugged, Compact Atomic Clock Laser with a Path Toward Flight Qualification

**FREEDOM PHOTONICS, LLC**

Santa Barbara, California  
Widely Tunable Fast Semiconductor Laser Seed Source at 1045 nm for Lidar Remote Sensing

**ATLAS SPACE OPERATIONS**

Traverse City, Michigan  
Cognitive Constellation Management Scheduling  
**QORTEK, INC.**

Williamsport, Pennsylvania  
Fast Transient Response High Voltage Power Converter for Space Applications

**INNOFLIGHT, INC.**

San Diego, California  
InnoSwitch – A Flexible HPSC Switch/Router

**STELLAR SCIENCE LTD. CO.**

Albuquerque, New Mexico  
Efficient Realistic Conjunction Analysis

**NABLA ZERO LABS**

San Marino, California  
A Networked Flight Dynamics Platform for Collaborative Design and Optimization

**FREEDOM PHOTONICS, LLC**

Santa Barbara, California  
Integrated RF Photonics Channelizer and Down Inverter

**BEAM – CA, LLC**

Long Beach, California  
Vector Magnetometer Based on Spin Wave Phased-Array Antenna

**ADVANCED COOLING TECHNOLOGIES, INC.**

Lancaster, Pennsylvania  
Variable Conductance Cold Plate for Spatial and Temporal Temperature Uniformity

**TIETRONIX SOFTWARE, INC.**

Houston, Texas  
Model-Based Engineering Trade Evaluation Tool Suite

**SEEQC, INC.**

Elmsford, New York  
Two-Dimensional Cryogenic Readout for Far IR Bolometers

**MIRIOS, INC.**

Santa Barbara, California  
The Regents of the University of California, Santa Barbara  
Santa Barbara, California  
Multispectral Mid-Infrared Laser

**MULTI3D, LLC**

Cary, North Carolina  
Duke University  
Durham, North Carolina  
Rapid Prototyping of Beam-Shaping Metamaterial Antennas via Additive Manufacturing of a Highly Conductive Filament

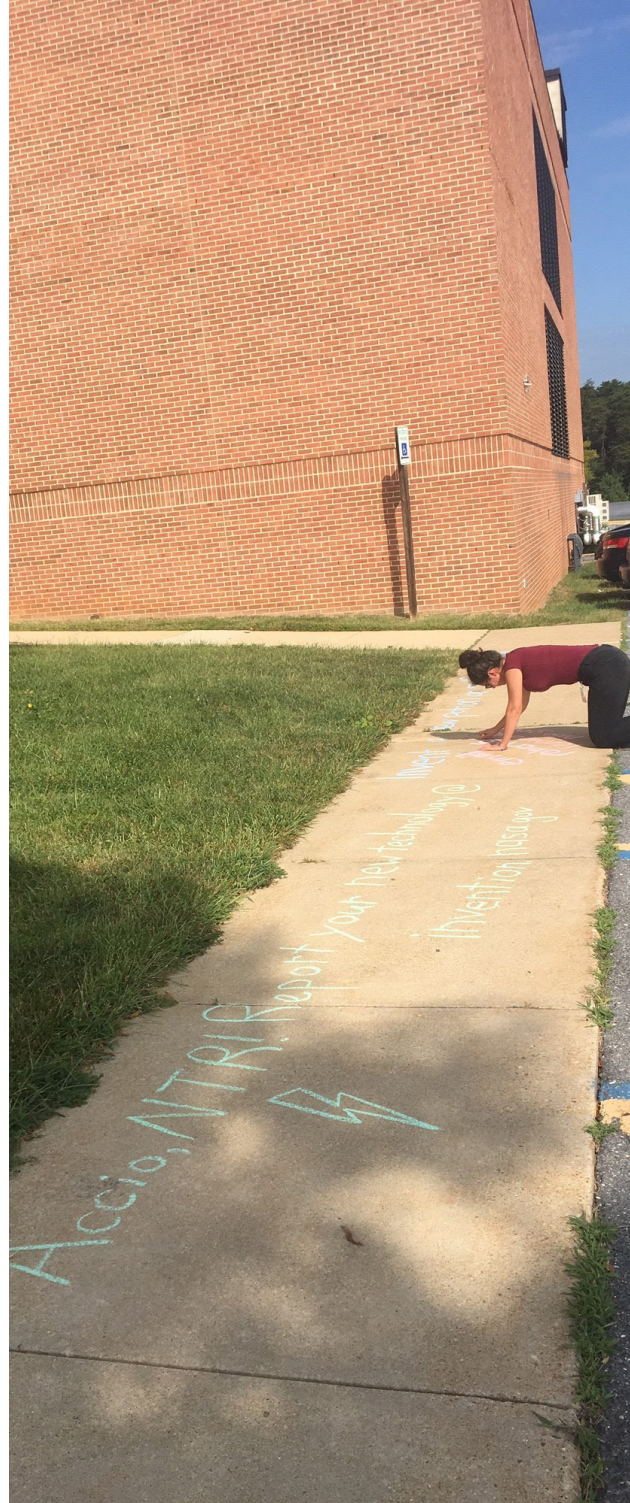
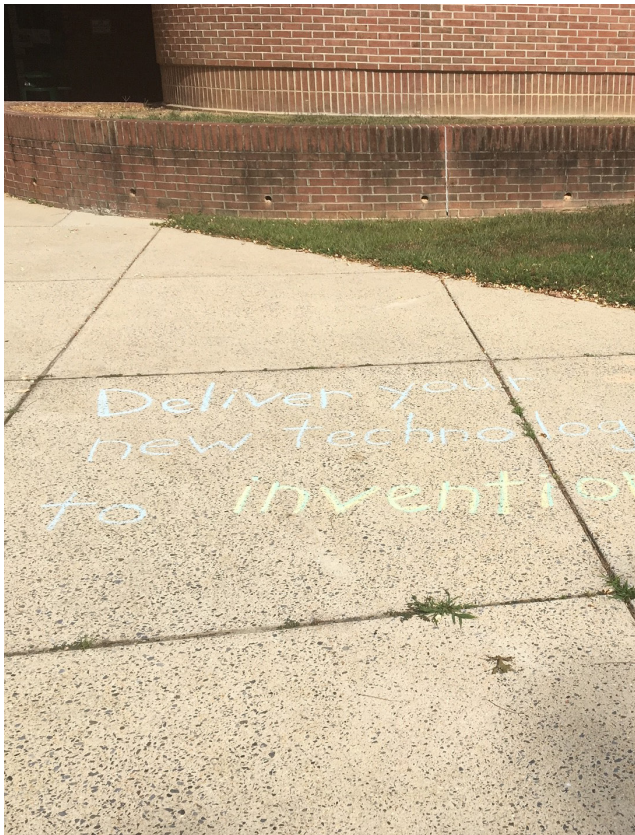
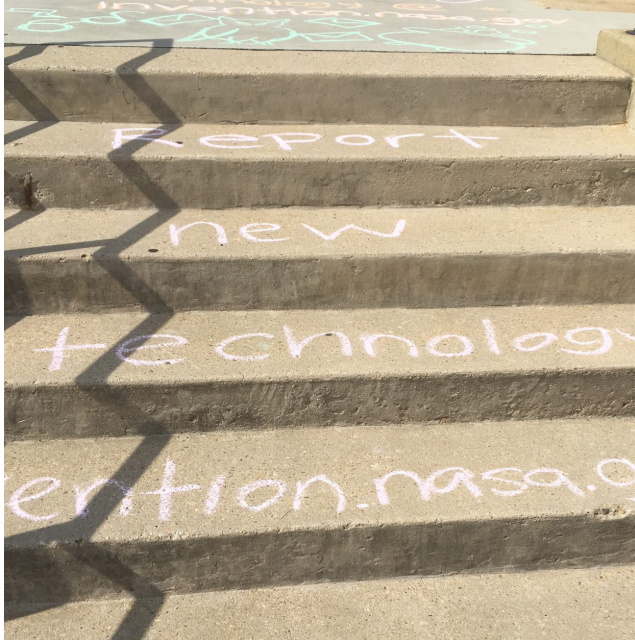
**ULTRA LOW-LOSS TECHNOLOGIES**

Santa Barbara, California  
The Regents of the University of California, Santa Barbara  
Santa Barbara, California  
Broadband Arrayed Waveguide Grating with Microwave Kinetic Detector Array for Fully Integrated High-Resolution Photonic Spectrograph

**NANOHMICS, INC.**

Austin, Texas  
Research Foundation of the City University of New York – Advanced Science Research Center  
New York, New York  
Metagrating Beam Shaping Optics





# SPO HITS THE STREETS OF NASA'S GODDARD SPACE FLIGHT CENTER

How do you get the attention of NASA's brilliant but busy scientists and engineers? SPO tried something new this year – we took to the streets and wrote messages in sidewalk chalk to remind innovators about reporting their new technologies to SPO. With colorful drawings and eye-catching calligraphy, the messages created a buzz around campus and raised awareness of technology transfer at Goddard. Even at NASA, sometimes it's wise to go back to the basics.



HOW MANY MORE YEARS I SHALL BE ABLE TO WORK ON THE PROBLEM I DO NOT  
KNOW; I HOPE, AS LONG AS I LIVE. THERE CAN BE NO THOUGHT OF FINISHING,

**FOR 'AIMING AT THE STARS'**

BOTH LITERALLY AND FIGURATIVELY, IS A PROBLEM TO OCCUPY GENERATIONS,

SO THAT NO MATTER HOW MUCH PROGRESS ONE MAKES,

**THERE IS ALWAYS THE THRILL  
OF JUST BEGINNING.**

**ROBERT H. GODDARD**



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