VOLUME 9 NUMBER 1 | FALL 2017

National Aeronautics and Space Administration

Kennedy Space Center

Tech Transfer News

IN THIS ISSUE:

Howard Levine is the Chief Scientist for NASA's ISS Research Office. See pages 6-7 to learn more about Howard's work in the Space Life Sciences Labs to grow plants in deep space.

Photo credit:
Tony Gray and Sandra Joseph

Jonathan Leahy

Esteemed member of the Intellectual Property Legal Team

Jonathan Leahy recently joined NASA's Office of the Chief Counsel at Kennedy Space Center (KSC) as a member of the Intellectual Property (IP) Legal Team. Jon is a licensed attorney in New York State and is also a registered patent attorney authorized to practice in front of the United States Patent and Trademark Office (USPTO). His primary responsibilities for the IP Legal Team will be assisting the Technology Transfer Program with patentability assessments for KSC developed technologies that have high commercialization and licensing potential. In this role, he will also be preparing patent applications and responding to actions from the USPTO on NASA's patent applications, as well as drafting patent license agreements. Before joining NASA as an IP Attorney, Jon worked as a technology transfer specialist for the Engineering Services Contract supporting the NASA Technology Transfer Program at KSC. His familiarity with KSC's technology portfolio, as well as the scientific and engineering community at KSC, makes Jon a perfect addition to the IP Legal Team. Jon has held several positions within the field of technology transfer for various companies where he was responsible for technology marketing, IP licensing, and managing corporate copyrights and trademarks. It is also worthy to note that Jon is a patented inventor on two technologies he co-developed to assist people with disabilities. It goes without saying that Jon is a value-added addition to the NASA KSC IP Legal Team. ▲

Jonathan Leahy

The Space Race

Encouraging entrepreneurial startups to utilize space technology

The Center for Advancing Innovation (CAI) partnered with the National Aeronautics and Space Administration (NASA) in an unprecedented initiative to encourage entrepreneurs to form startups using space technology - the SPACE RACE. The SPACE RACE is a first-of-its-kind global initiative, which was formed in partnership with NASA to encourage the use of federally-funded technologies by startup companies. The SPACE RACE Challenge is a great opportunity for entrepreneurs to jump start their career and learn about how to create and run businesses, while participating in a competitive and deliverable-driven environment. The competition is supported by CAI'S startup challenge-accelerator design, which provides training and expert mentorship to all participants. Topics covered include: business strategy, financial planning, and R&D strategy.

The SPACE RACE Challenge leveraged the benefits of the Startup NASA initiative, which is a licensing arrangement that eliminates fees for the first three years of commercial use of NASA's patented technologies. Startup NASA addressed two of the biggest challenges faced by startup companies: raising capital and securing intellectual property rights.

SPACE RACE
ENGAGE. COMPETE. LAUNCH.

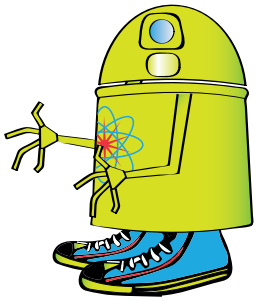
"The NASA invention portfolio is very advanced, and many of the inventions have multiple applications that are commercially viable. NASA's Kennedy Space Center technologies provide ideal platforms for launching new companies with world-class crowdsourced talent," said Rosemarie Truman, Founder and CEO of the Center for Advancing Innovation. "Coupled with NASA's new licensing agreement and our unique paradigm, we've created an unparalleled launch pad to accelerate and increase the volume of federally-funded invention commercialization," Rosemarie added.

Fifteen (15) winners and finalists of the SPACE RACE startup challenge were announced in the fall of 2016 by CAI. Startups launched from the SPACE RACE have moved on to Phase 3 of the challenge, where they are tasked with incorporation, licensing NASA technologies, and raising seed funding. Winners of this race from Kennedy Space Center included Sun City Smart Technology Solutions, Inc. and Minus Tau, both interested in commercializing KSC's In-Situ Wire Damage Detection and Rerouting System, and Native Coatings, which is interested in commercializing KSC's Liquid Galvanic Coating technologies for the protection of rebar in cement. ▲

SUN CITY SMARTTECH

MINUS TAU

NATIVE COATINGS



Aviation Technologies and the Alt Alert™

The Personal Cabin Pressure Altitude Monitor and Warning System, which won the NASA Commercial Invention of the Year and Government Invention of the Year awards for 2003, grew out of a project to create a vacuum chamber that would allow astronauts to work in emulated lunar and Mars environments. NASA's Jan Zysko, the inventor of the award-winning device, and his team were concerned about air evacuating the chamber while people were still inside. Depressurization of this kind can cause hypoxia, which is a state of oxygen deficiency in the blood, tissues, and cells sufficient to impair functions of the brain and other organs.

Alt Alert

KSC's Technology Transfer team at Kennedy Space Center saw a need for this technology in the aviation industry. After receiving a US Patent on the technology the team marketed the technology to the aviation industry and attended appropriate events including the Lakeland Florida's Annual Sun 'N Fun International Fly-in and Expo.

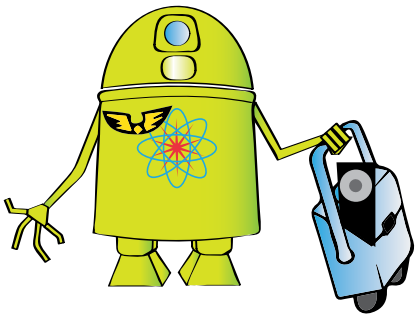
Persistence paid off and in 2007 Stacy Pappas Sawaya, an engineer from San Diego who had ties to the aviation industry through her father, a retired Delta pilot, FAA examiner, and flight instructor reviewed the technology. Sawaya reached out to the network and determined that there was a market for the monitor in the aviation industry. Sawaya took the lead and created a new startup company called Aviation Technology and applied and received a commercial patent license for the Personal Cabin Pressure Monitor in 2011.

With the advent of the Smart Phone, Sawaya designed the Alt Alert™ to be similar in size and shape of the cell phone. She improved upon the original concept and developed a model of the technology that features a small monitor with an integrated alarm and LED annunciation that will sound and flash a super-bright LED when the cabin pressure is approaching or exceeds a maximum safe operating altitude.

ALT ALERT™
BY AVIATION TECHNOLOGY™

The monitor also has a sleep mode and will only "awaken" and sound when the pressure is at an unsafe limit. It comes with three different mounting options, including a backing with suction cups for window mounting, a backing with Velcro for mounting against the instrument panel, and a clip to attach it to a visor.

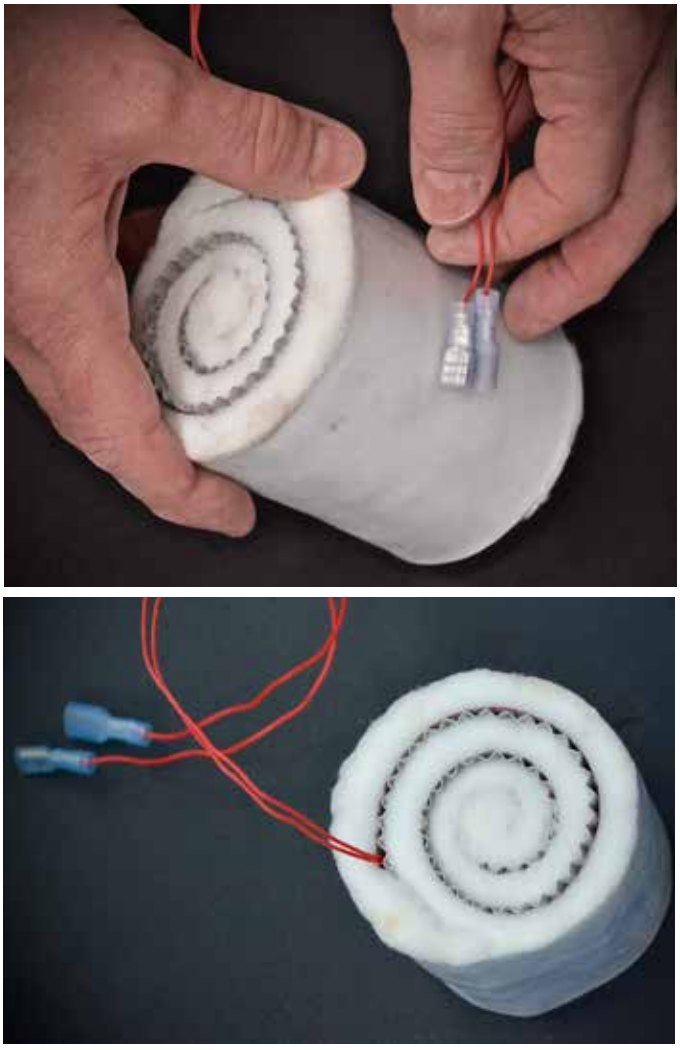
As an aftermarket product, the Alt Alert™ is an option for pilots of pressurized aircraft—jets or airliners that fly above 15,000 feet—to take with them in their professional pilot's flight bag. It is currently available for all pilots of pressurized aircraft in the United States, a market that could reach tens of thousands of customers. In the future, Sawaya plans to offer the technology to international markets as well. Aviation Technology sold their first Alt Alert™ units in August 2014 and have had a steady stream of business since. ▲



Cryogenic Capacitor

Cryo-Fluid Capacitor utilizes nano-porous materials

Engineers at the Cryogenics Testing Facility have created the Cryo-Fluid Capacitor (CFC) that capitalizes on the energy storage capacity of liquefied gasses and relative simplicity of high pressure gas bottles, while limiting the downfalls associated with both methods. By exploiting a unique attribute of nano-porous materials, aerogel in this case, fluid commodities such as oxygen, hydrogen, methane, etc., can be stored in a molecular surface adsorbed state at densities on par with liquid, at low to moderate pressure, and then supplied as a gas, on-demand, to a point of interest.



Lab Prototype of the Capacitor

Storage and transfer of fluid commodities such as oxygen, hydrogen, natural gas, nitrogen, argon, etc. is an absolute necessity in virtually every industry on Earth. These fluids are typically contained in one of two ways: 1) as low pressure cryogenic liquids, or 2) as a high pressure gases. However they have their limitations for practical use. High pressure gas must be stored in vessels with heavy thick walls and cryogenic liquids require complex storage systems to limit boil-off and are not well suited for overly dynamic situations where the tank orientation can change suddenly (e.g. in an airplane or car). The CFC addresses these issues, while still providing excellent energy storage capability.

The CFC technology includes ingenious packaging in its design. Tightly coiling aerogel blanket into a cylinder allows for a larger amount of the storage media (aerogel) to be densely packaged into a manageable geometry, yet won't allow the cryogenic fluid to easily penetrate the cylinder for fast charging. A spirally-integrated conductive membrane also acts as a large area heat exchanger that easily distributes heat through the entire cylinder to discharge the CFC quickly, and can be interfaced to a cooling source to charge it up; this feature also allows the cryogenic fluid to easily penetrate the cylinder for fast charging. Another important note is that the unit can be charged up with cryogenic liquid or from an ambient temperature gas supply, depending on the desired manner of refrigeration. Another novel feature is the heater integration. Two promising methods have been fabricated and tested that evenly distribute heat throughout the entire core, both axially and radially. ▲

Space Life Sciences Lab

Growing food in deep space for extended duration missions

All organisms grow differently in space. Future long-duration space missions will require crew members to grow their own food; so understanding how plants respond to microgravity is an important step toward that goal. NASA's Space Life and Physical Sciences Division supports research on this subject in laboratories at NASA Centers, in university and commercial laboratories, and most importantly on multiple spaceflight platforms, including the International Space Station (ISS) and free-flyer satellites launched using expendable rockets.

Howard Levine, the Chief Scientist for NASA's ISS Research Office, leads a research group at Kennedy Space Center who design and conduct experiments that deal with growing plants in the microgravity environments of space. This research put lettuce on the menu for the first time for NASA astronauts on the ISS last year. Expedition 44 crew members, including NASA's one-year astronaut Scott Kelly, grew and sampled the fruits of their labor when they harvested a crop of red romaine lettuce from the Vegetable Production System (Veggie) on the nation's orbiting laboratory.

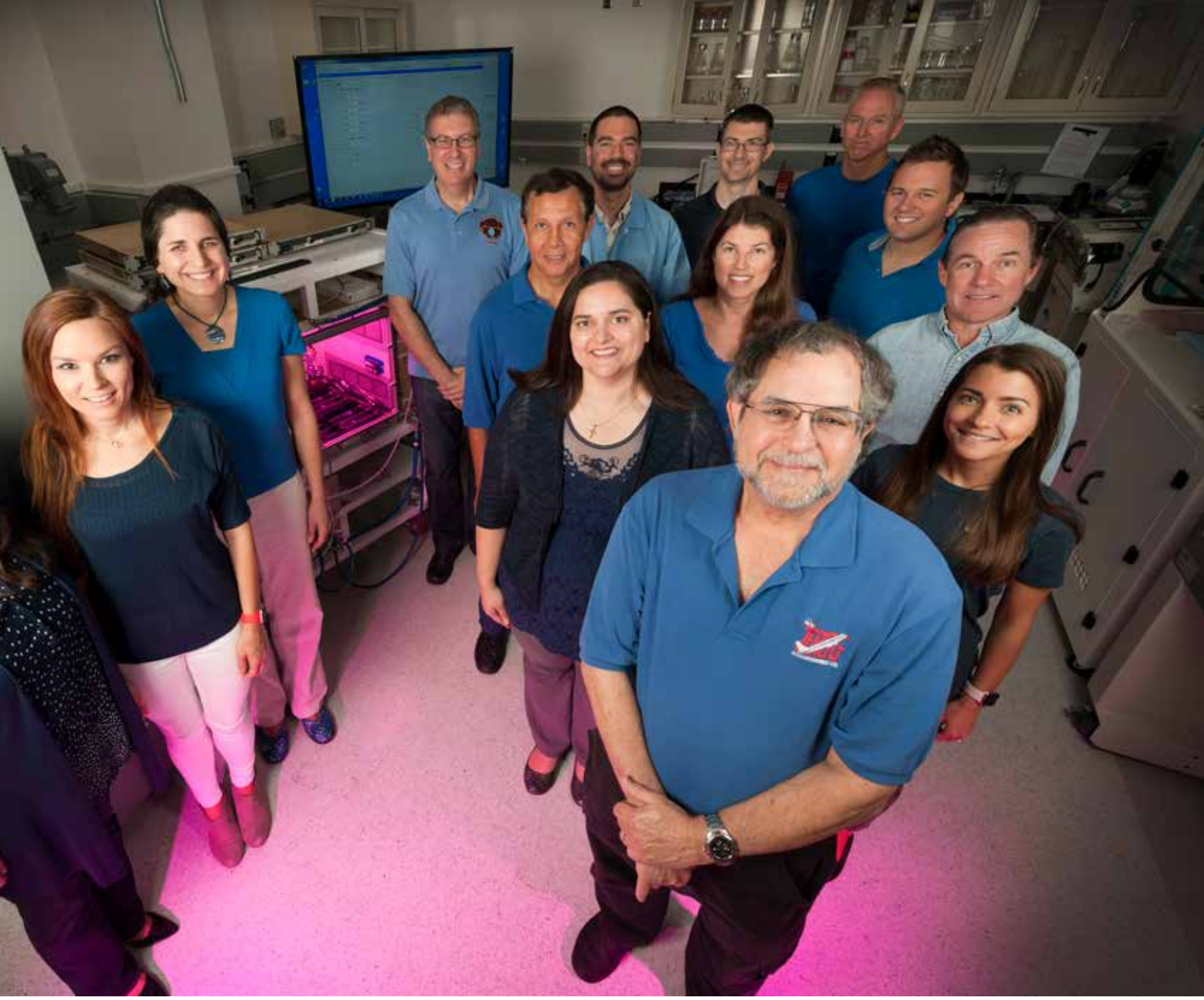
Veggie was developed by Orbital Technologies to be a simple, easily stowed and high growth volume, yet, low resource facility capable of producing fresh vegetables on the ISS. In addition to growing vegetables in space, Veggie can support a variety of experiments designed to determine how plants respond to microgravity, provide psychological benefits for the crew, and conduct outreach activities. Currently, Veggie provides the largest volume available for plant growth on the ISS.

NASA's first plant experiments in Veggie, called Veg-01 and Veg-03, were used to study the on-orbit function and performance of the Veggie and its rooting "pillows," which contain the seeds and growth medium. Through numerous tests the Veggie science team has refined the pillow concept and selected growth media and fertilizers, plant species, materials, and protocols in Veggie to grow healthy plants that can provide the crew with food and recreation.

The Passive Orbital Nutrient Delivery System (PONDS) is an improved plant growth approach that is composed of both an area for a contained plant growth substrate and a reservoir for water and/or plant nutrient solutions. PONDS was developed to fit beneath the Veggie light cap and replace the current rooting "pillows." PONDS provides reliable water delivery to seeds for germination (while avoiding overwatering). This fulfills the requirement to transport water from the reservoir for improved plant growth while providing adequate nutrients and aeration to the root zone under both 1g and microgravity conditions.

The Advanced Plant Habitat (APH), that will be launching to ISS this year, is a large growth volume plant habitat, capable of hosting multi-generational studies, in

Example of Veggie and APH experiments at KSC.



Members of the KSC Space life and Physical Science Lab gather next to the APH. Back row (left to right) Jeff Richards, John Catechis, Clayton Grosse, Jim Smodell, and Gerard Newsham. Second row (left to right) Gioia Massa, Oscar Monje, Kelli Maloney, and John Carver. Third row (left to right) Stephanie Richards, Victoria Long, and Kamber Scott. Front row (left to right) Dinah Dimapilis and Howard Levine. Photo credit: Tony Gray and Sandra Joseph

which environmental variables (e.g. temperature, relative humidity, light intensity) can be tracked and controlled in support of whole plant physiological testing (up to 135 days) and Bio-regenerative Life Support System (BLSS) investigations. The BLSS approach capitalizes on the ability of plants to produce oxygen, remove carbon dioxide, purify water, and produce food. It therefore holds promise for reducing requirements for resupplying these commodities for long duration space missions. Given the cost of launching supplies into space (a value of $10,000/lb is often used), this approach can dramatically reduce costs associated with spaceflight. ▲

Behind the Scenes with the Unsung Heroes of the KSC Legal Team

When talking about the NASA Intellectual Property (IP) Legal Team, most people think of the patent attorneys who help protect NASA's groundbreaking inventions. However, the IP team is much more than just its attorneys. Paralegals Ginger Arrington and Dawn Feick are invaluable members of the team, providing critical support to not only the patent attorneys, but the researchers as well.

Ginger Arrington

Dawn Fieck

Ginger began her NASA career as a co-op in 1991 at Langley Research Center (LaRC) where her talents propelled her to the Technology Transfer Office from 1994-2000. She moved to the LaRC Office of the Chief Counsel in 2001 and eventually to KSC in 2005 as a Patent Paralegal. At KSC, Ginger's primary responsibilities are the preparation and management of patent related legal documents, such as patent applications, responses to office actions from the United States Patent and Trademark Office (USPTO), and license agreements. In addition, she manages the IP docket and tracks all aspects of the patent prosecution and licensing processes, including all USPTO filing and fee payment deadlines. Ginger also administers and processes royalties received from patent licensing on behalf of the KSC Technology Transfer Program, which includes calculating the NASA inventor-share of royalties.

In 1986, Dawn began her NASA career at Goddard Space Flight Center (GSFC), eventually moving to NASA headquarters in 2003 to assist with the Columbia Accident Investigation team. Dawn became a paralegal in 2005 within the GSFC Office of the Chief Counsel before moving to her current position within the KSC Office of the Chief Counsel in 2008. Dawn assists the IP team with a myriad of tasks. She prepares all documents related to copyrights within the office, which entails securing copyright assignments from contractors, as well as registering those copyrights with the Library of Congress. Dawn also manages the IP invention rights determination process for the Patent Counsel, which requires her to interface with NASA contractors to obtain invention title elections and patent waiver documents. In her dual role as the Ethics paralegal with the Office of the Chief Counsel, Dawn also helps the IP team research many ethics issues that arise when NASA collaborates with external entities.

As you can see, the behind-the-scene efforts by both Ginger and Dawn are substantial and their diligence and professionalism keep the IP Legal Team seamlessly moving forward. ▲

Leveraging Research Opportunities

Ammonia recovery system for wastewater facilities and the ISS

Griffin Lunn, Sustainable Systems Engineer for SGT, is developing the Ammonia Recovery System for Wastewater for potential use as part of the Environmental Control and Life Support Systems (ECLSSs) on the International Space Station (ISS). The system uses an affordable media that is highly selective for ammonia. Ammonia concentrations in wastewater as high as 100,000 ppm can be reduced to less than 1 ppm. Following treatment, the media is regenerated for reuse in the system and ammonia is captured as a by-product.

On Earth, this technology could be used for ammonia recovery from municipal and industrial wastewater treatment facilities. However the technology needed further development and there was not much funding for that. NASA Technology Transfer Office (TTO) selected the technology and submitted it to the Florida Space Grant Consortium which funds development of space technologies. The Consortium reached out to Florida based universities with a call for further development and possible commercialization of the Ammonia Recovery System.

Florida International University (FIU) was awarded funding by the Consortium to evaluate the technology for implementation at large scale wastewater treatment plants. Under an Evaluation License, FIU, in cooperation with the South District Waste Water Treatment Plant in Miami-Dade County, evaluated the Ammonia Recovery System for Wastewater technology using real-world wastewater

samples. The university matched the funding of the Consortium.

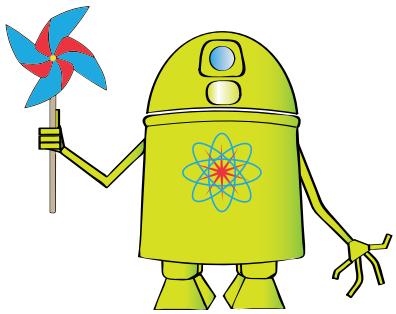
Based on the positive relationship with FIU, Griffin Lunn saw an opportunity to seek additional funding from KSC's Center Innovation Fund by partnering with an additional Florida university, the University of Central Florida. NASA reviewed the proposal and awarded the project funding for technology development. The three partners are currently working in tandem to move the technology forward while the TTO is marketing the patent pending technology to industry seeking a commercial company that can scale up the system for wastewater treatment. ▲

Fiber Optic Sensing System

Providing the ability to instrument large structures with multiple strain sensors

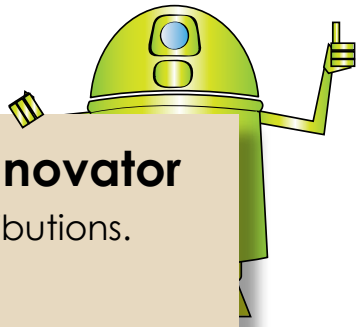
Rocket launch vehicle control systems must sense and correct minute deviations of the vehicle from the desired course. Modern and historical control system designs reflect the limited information provided by the available sensors. All rockets use sensor packages known as Inertial Measurements Units (IMU). The IMU is an integrated sensor package that provides sensed acceleration and angular rates. This information is used by the Guidance Navigation and Control (GN&C) system to determine the rockets position, velocity, and attitude. These specific characteristics of the rocket are also known as the rigid body motion. One of the significant challenges to control system design is that the IMU senses flexible body motion as well as rigid body motion. Since the IMU cannot discern between rigid body and flexible body motion, the rocket control system will respond similarly to both types of motion. This unfortunate reality means that the control system response is not ideal for either rigid body or flexible body motion control. At a mission level the net effect is a compromise to launch availability and performance.

The GN&C group within the Launch Services Program (LSP) located at NASA Kennedy Space Center (KSC) put forth an effort to improve Launch Vehicle (LV) control systems utilizing the new enabling technology of Flexible Fiber Optic Sensors (FlexFOS). FlexFOS provides the ability to instrument a large structure such as Rocket LV with multiple strain sensors that can be used to provide flexible information of the LV to the control system. This technology coupled with newly developed algorithms gives the control system the ability to discern between flexible dynamics and rigid body dynamics. The new capabilities provided by the FOS system configured for flexible control are: vehicle shape sensing in real time, virtual IMU sensors, bending energy measurements, increased control system robustness, and increased resolution on flight margins across multiple disciplines. Here on earth the FlexFOS could be used on Windmill Turbine Blades and large cranes. ▲



KSC TTO Presents Patent Awards to Inventors

KSC's KickStart Showcase was held this year giving innovators the opportunity to display their technologies following the culmination of this year's program. Innovators were able to network with each other as well as the Technology Transfer Office and other attendees in an open forum. The KickStart program at KSC provides seed funding for innovative ideas and early stage technologies. The Showcase was held in conjunction with the Patent Award presentations in order to demonstrate the full cycle of innovation from idea to patenting to Technology Transfer. Twenty-two KSC inventors were recognized for their contributions to 18 issued patents over the last two years. Center Director, Bob Cabana, and Patent Counsel, Shelley Ford, presented each inventor with a plaque commemorating their patented technologies. More than 100 KSC personnel attended the patent award presentation. ▲



Thank you for being a KSC Innovator

We look forward to your future contributions.

New Technology Reporting:
http://invention.nasa.gov

KSC New Technology Transfer Office

Contact KSC New Technology Representatives
Meredith Reeves or Megan Victor for more information
ksc-newtechnology@mail.nasa.gov

Space Technology Hall of Fame

Florikan's Ed and Betty Rosenthal, and NASA's Dr. Gioia Massa, observe ground control experiments in the Veggie Lab.

The Kennedy Space Center, along with partners Florikan ESA and Florida Space Alliance Technology Outreach Program were inducted into the Space Technology Hall of Fame (STHF) at the 33rd Space Symposium. KSC and Florikan collaborated over a span of more than 10 years to develop the Staged Nutrient Release fertilizer that has both commercial applications and is now being used on the Veggie plant growth system on the International Space Station. The technology requires far fewer applications of fertilizer throughout the year, thus reducing overall costs and significantly mitigating the environmental impacts of over fertilizing and runoff. KSC Center Director, Robert Cabana, accepted the award on behalf of KSC. ▲

KSC Technologies

International Builder's Show

Representatives from the Technology Transfer Office met with dozens of companies interested in KSC technologies at our booth at the International Builders Show in Orlando, FL. The insulations at the Cryogenics Lab and the advanced materials from the Applied Chemistry and Polymer labs were featured at this show. The show was well attended by more than 80,000 people in the construction industry. ▲

Tech Transfer display at International Builder's Show.

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SP-2017-01-083-KSC

TECHNOLOGY TRANSFER PROGRAM

Kennedy Tech Transfer News is the magazine of the Technology Transfer Office at NASA's Kennedy Space Center, Florida.

This magazine seeks to inform and educate civil servant and contractor personnel at Kennedy Space Center about actively participating in achieving NASA's technology transfer and partnership goals.

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