National Aeronautics and Space Administration

NASA

KSC NEWS

tech transfer

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KSC wins Commercial Invention of the Year

See page 11 for details

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Photo credit: Tony Gray, Abacus Technology

Tracy Gill, Deputy Chief Technologist for KSC

Tracy Gill

> ***"I can remember watching one of the final Apollo moon landings when I was three or four years old and I was fascinated."***

Tracy Gill serves as the Deputy Chief Technologist for KSC. He is responsible for top-level Research and Technology (R&T) strategy and roadmap development while developing Dual Use Technology Development Partnerships involving leveraged funding provided by external partners. Tracy represents Kennedy Space Center (KSC) on Agency and intergovernmental boards, panels, and teams to establish, modify, and execute top-level R&T strategy and roadmap development. For example, he serves on the Research and Technology Management Board aimed at increasing current research and technology efforts and fostering collaboration among existing technology areas within KSC and with other Centers. Tracy also manages NASA's eXploration Habitat, or X-Hab, challenge, in which students from leading universities all around the country develop concepts and prototypes and share lessons learned that will help shape future space missions.

Tracy knew at a very young age that he wanted to work for NASA. "I can remember watching one of the final Apollo moon landings when I was three or four years old and I was fascinated," Tracy recalls. Not only did he grow up in Florida and see many launches firsthand, but he was also a huge Star Wars fan, which influenced his path for the future. In high school, he wrote a paper on America's space program, noting that he was going to make this his career. In 1989, he graduated with an electrical engineering degree from the University of Florida.

One month after graduation, Tracy joined NASA at KSC, supporting space shuttle payload integration. Many of his early efforts at Kennedy focused on preflight processing of experiments for shuttle Spacelab missions, coordinating efforts from other NASA field Centers, contractors, universities, and international engineering teams from the European Space Agency (ESA), Italy, Germany, Canada, and Japan. This kind of work evolved into coordinating major payloads for flights to the International Space Station.

"I've gone from working with mature hardware designs about to fly right away to helping develop technologies for future exploration habitats," Tracy says. "I've been fortunate to work with diverse teams from multiple NASA Centers and our international partners. This has helped prepare me for collaboration with academia and industry as we develop complex habitats that will be crucial for long-duration space missions."

Tracy is a season ticket holder for University of Florida football games and takes his two sons back to Gainesville to cheer on his team. Tracy enjoys taking his oldest son to Star Wars conventions and is especially looking forward to traveling to San Diego this July for Comic-Con International. And when Tracy isn't working hard at KSC, you can also find him training for events like the Star Wars half-marathon at Disney. ▼

Exploration Research and Technology Programs

FNETT Encourages Tech Partnerships Across Florida

The Technology Transfer Office Partnerships Manager, Mike Lester, is leading an initiative to develop a diverse network of Florida organizations to support businesses, entrepreneurs, investors, and local governments, including those that provide entrepreneurial/innovation training and funding for applied research within Florida universities. The network he is creating is called the Florida Network for Engaging in Technology Transfer or FNETT. Through the network, Mike hopes to encourage the creation of new businesses commercializing NASA technologies, the transfer of NASA technologies to established businesses and city/county governments, and the testing/evaluation of new technologies at KSC's facilities. Mike has been traveling across the state making presentations on how the community can partner with NASA.

In one recently created partnership, the Florida Space Grant Consortium (FSGC) and the Technology Transfer Office are establishing a pilot program for advancing NASA technologies. The program seeks to provide Florida universities with a competitive opportunity to further develop KSC-patented technologies for commercial applications, and for NASA space applications if the technology has dual use potential. The program will be administered by FSGC. To initiate the pilot, FSGC and NASA collaborated to identify two early-stage patented KSC technologies that fit the profile for this program.

FSGC issued a request to Florida universities for proposals to further develop these technologies for commercial applications and this year awarded $25K in funding to two universities for technology development. The universities provided matching funds under an Evaluation License Agreement with NASA. Project results will benefit NASA as well as the laboratory that invented the technology and could lead to follow-on work in partnership with NASA or through the Small Business Innovation Research/Small Business Technology Transfer program.

Meanwhile, Mike Lester will continue to seek new partnerships for advancing and licensing NASA technologies here in Florida. ▼

Technology Transfer Begins with You!

Your ideas are the catalyst

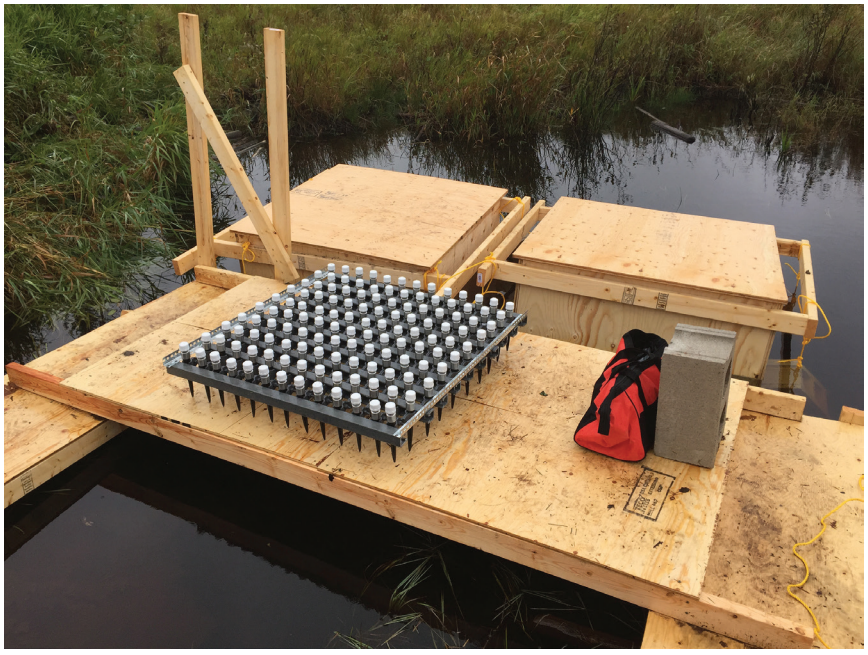
...they make NASA's missions successful, including the mission to transfer technology. If you don't know where to start, we can help. From filing a New Technology Report to understanding the partnering process, please contact the KSC Technology Transfer Team.

Golder Associates Evaluating Innovative Remediation Technology

Golder Associates, a global engineering and construction company is evaluating NASA's Sorbent Polymer Extraction and Remediation System (SPEARS) under a nonexclusive evaluation license agreement it recently signed with Kennedy Space Center. SPEARS is a unique spiked system designed to remove polychlorinated biphenyls (PCBs) from sediment.

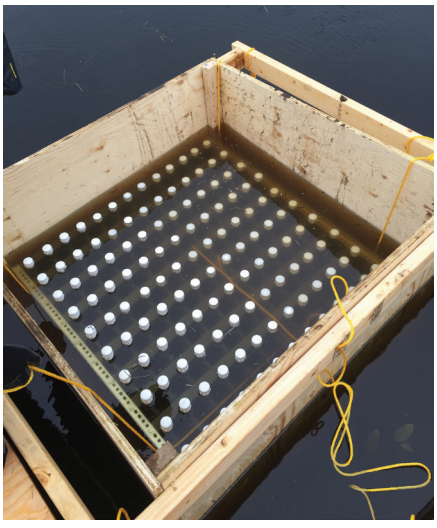
PCB-contaminated sediment is a serious problem at sites around the globe. The only methods available to address these sites are dredging (removing the sediment) or capping (covering the sediment). Dredging merely moves the problem from one location to another (a landfill), and capping does nothing to treat the contamination. It simply covers it up.

SPEARS is a system of ethanol-filled plastic spikes fitted into square or rectangular plates that fit together to form a blanket covering targeted sections of a PCB-contaminated sediment site. The system, which is lowered section by section into the moist sediment, is passive in nature and works by attracting PCBs out of the sediment and trapping them in the plastic spikes. This process can take months to complete, and spikes can be removed and replaced as they become saturated with PCBs. Over time (and with multiple treatments, if needed), the concentration of PCBs in the sediment can be reduced to acceptable levels.



Prototype just before deployment.

Working with a large client company, Golder Associates has constructed a prototype variation of the SPEARS technology that uses individually sealed ethanol-filled spikes attached to a durable, corrosion-resistant frame. In September of 2015, the prototype was deployed at a site in Canada to evaluate its effectiveness in reducing low-level PCB concentrations in sediment over time. The prototype will remain in place for one year, after which time the equipment will be retrieved, and posttreatment sediment samples will be analyzed for comparison to baseline concentrations. If the technology proves effective, the client company may deploy it at other sites where PCB-contaminated sediment is present. Golder worked closely with the technology development and technology transfer teams at KSC to understand and deploy the system and obtain the license needed for its evaluation. ▼



Immersion in South Cell.

Lighting System to Improve Circadian Rhythm Control

What is it?

The Lighting System to Improve Circadian Rhythm Control is a programmable solid state general illumination fixture with full intensity and color temperature control. This new lighting assembly uses a microcontroller with power relay to adjust color temperature and perceived intensity to simulate a practical diurnal cycle.

Why was it needed?

The lighting system was designed and built to help regulate the sleep cycles of astronauts working on the International Space Station and during long-duration spaceflight. In space, the lack of a true diurnal cycle of sunlight, encompassing the same range of color temperatures and intensities as the sunlight that reaches Earth, is one of the potential causes of sleep disorders among ISS crews. The production of melatonin, a hormone that helps regulate sleep cycles, can be inhibited by light, especially cool white light (with its large blue light component). To help regulate sleep cycles and improve the quality of sleep for the crew, control of the melatonin production cycle through the use of light is key.

What makes it better?

The system allows the color temperature of light to be fully adjustable over the entire range of temperatures. Light intensity varies from a low "night light" level (to minimize or eliminate any delays to the onset of the crew's REM sleep) to a daylight or work mode that can help the crew concentrate on their normal workday tasks. A manual mode can be used to override the automatic diurnal cycle for out-of-cycle work requirements. Blue light can be added to assist with circadian rhythm adjustment should sleep cycles need to be changed. The microcontroller takes the primary control of the lighting scheme rather than a master controller, making individualized therapies possible.

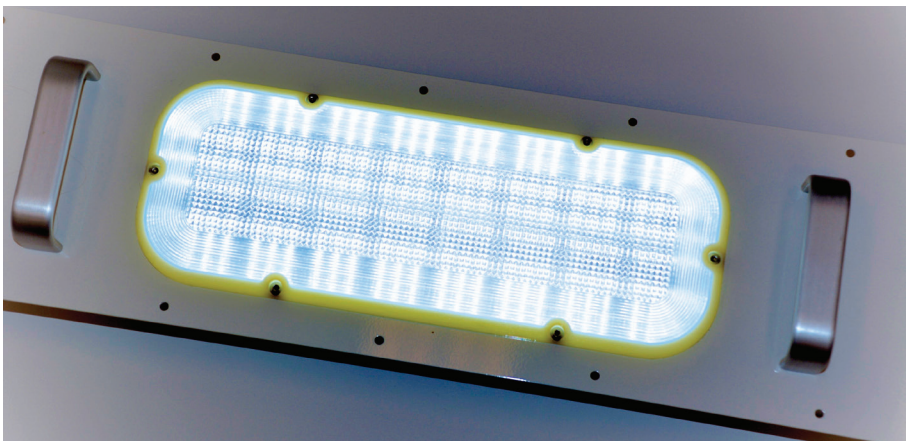
In operation, the intensity of light gets brighter as the workday proceeds, and the color temperature gets progressively higher (corresponding to a cooler color of light) to mimic the diurnal cycle. As the workday ends, the light gets only slightly dimmer, but significantly lower in color temperature (corresponding to a warmer color of light). As the sleep cycle begins, the light intensity dims, exposing occupants to even less blue light. To help regulate sleep cycles, this programming cycle mimics the same range of color temperatures and intensities of sunlight.

How can it be used?

On Earth, this technology can be used to help treat many sleep disorders, including jet lag, shift-work sleep disorder, delayed sleep phase syndrome, advanced sleep phase syndrome, and non-24-hour sleep/wake disorder. (The latter frequently affects those who are totally blind since the circadian clock is set by the light-dark cycle over 24 hours.)

Technology Transfer Status

The Lighting System to Improve Circadian Rhythm Control is patent pending and available for licensing to industry. ▼



Lighting System for Improving Circadian Rhythm Control prototype designed for Space Station applications.

Swamp Works – Developing New Tools for Deep Space Exploration

Kennedy Space Center's Swamp Works is a hands-on, lean development environment for innovation following the philosophies pioneered in Kelly Johnson's Skunk Works and Werner von Braun's development shops. The Swamp Works establishes rapid, innovative, and cost-effective exploration mission solutions through a highly collaborative, "no walls" approach, leveraging partnerships across NASA, industry, and academia. The goal of Swamp Works is to accelerate innovation for NASA and for benefits on Earth, from the idea stage, through development, and straight into application. Iterative testing is performed in the early stages to quickly drive design improvements. This rapid-development approach supports NASA's mission to provide Government and commercial space ventures with technologies they need for working and living on the surfaces of the Moon, planets, and other bodies in our Solar System. Current capabilities include facilities and world-class expertise from the Science and Technology Projects Division at KSC, in such areas as applied physics, applied chemistry, granular mechanics and regolith operations, cryogenics, electrostatics and surface physics, regolith activities testing, and for robotics integration, checkout and assembly, corrosion technology, and advanced materials and polymer science.

Staffed with engineers, physicists, and chemists, the labs use a "make it, test it, and improve it" model of work, one in which projects often undergo several generations of builds, each an inexpensive attempt to improve on the one before. The research labs maintain continuity of knowledge between generations of designs because the same team works on successive generations. Rather than looking for incremental advances, Swamp Works research teams strive for quantum leaps through rapid prototyping and experimentation. Open collaboration allows researchers to learn from each other and ask questions during a technology's development. The Swamp Works vision is to be the premiere Government research and technology incubator for development of spaceport systems on Earth or at any space destination. One important area of development is *in situ* resource utilization (ISRU), where the Swamp Works approach of rapid-concept-to-application has resulted in the development of several unique tools for future space exploration.

RASSOR

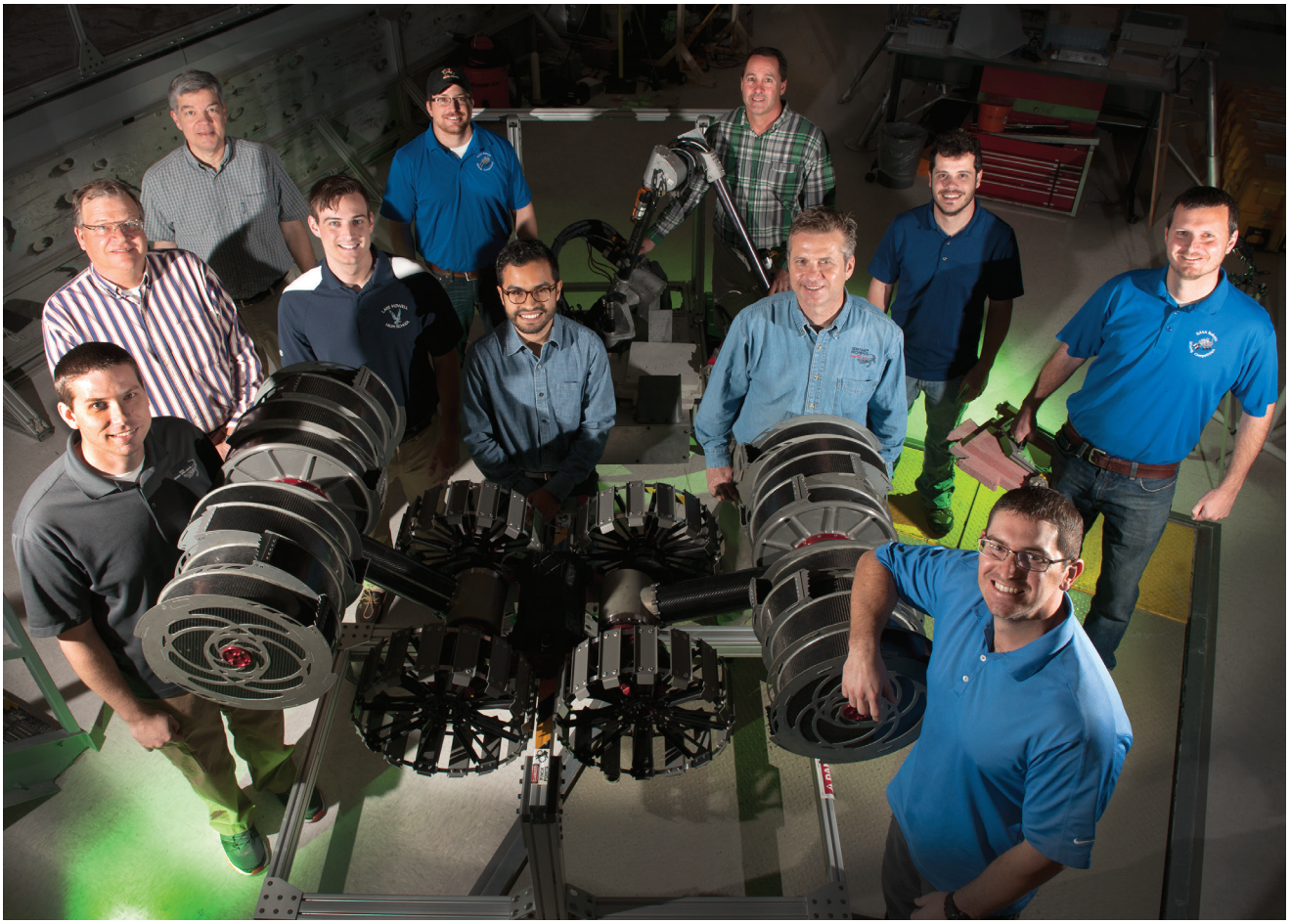
One area of focus at Swamp Works is the engineering and science of dealing with space dirt—also known as regolith. Regolith, when mined effectively, can be a valuable resource for producing water, breathing air, and propellants for long-duration missions beyond low-Earth orbit. RASSOR is a robot designed to excavate regolith on an extraterrestrial surface with very low gravity, such as the Moon or an asteroid. The excavator can traverse steep slopes and rough terrain, and its symmetrical design enables it to operate in reverse so that it can recover from overturning by continuing to dig in the new orientation.

Unmanned Aerial Vehicles in Space

Swamp Works is also focusing on how to prospect for resources on planetary bodies or asteroids. One method being explored is the use of unmanned aerial vehicles (UAVs). These new machines, called Extreme Access Flyers, have no rotors and use jets of oxygen gas or water vapor to move around, depending on whichever gas is available on the planet or asteroid the robots are exploring. With that fuel, they can maneuver quickly and forage for soil samples in areas inaccessible to traditional landers.

Swarmies

Swarmies are small robotic vehicles equipped with sensors, a webcam, GPS system, and Wi-Fi antenna.



The KSC Swamp Works team. Back row (left to right) Jim Mantovani, Nathan Gelino, Van Townsend and AJ Nick. Middle row (left to right) Tom Lippitt, Kevin Grossman, Armando Delgado, Rob Mueller, and Matt Nugent. Front row (left to right) Jason Schuler and Drew Smith.
Photo credit: Tony Gray, Abacus

They operate autonomously and can be programmed to communicate and interact as a collective swarm, which can dramatically improve the ability for robots to efficiently locate, identify, and collect resources over large and previously unexplored territories. In addition to being the most effective way to scour large areas for resources, robotic swarms are more robust, flexible, and scalable than robots operating alone.

Regolith Bin

Swamp Works recently constructed a regolith test bin, nicknamed the "Big Bin," which is believed to be the largest indoor, climate-controlled facility of its kind, measuring 26 feet on each side and packed with 120 tons of gray, simulated space dirt. It is helping engineers and scientists test mining technologies that could enable future explorers to live on another planetary surface by harvesting resources such as oxygen and water.

Electrostatic Dust Shield

One of the challenges in exploring the Moon or planets is dust created by rocket engines during landing or by human and mechanical activities taking place on the surface. Scientists in the Electrostatics and Surface Physics Laboratory are developing ways to mitigate this problem. One

Continued on page 8

NASA Launches New Startup Licensing Program

NASA recently began a new initiative aimed at helping new startup companies obtain affordable access to the Agency's patented technologies. The program addresses two of the biggest challenges facing startups: raising capital and securing intellectual property rights. The program is open only to U.S. companies that have been newly formed specifically to commercialize the licensed NASA technology.

To help the fledgling companies with cost, NASA waives the initial licensing fees and there are no minimum fees for the first 3 years. Once the company starts selling a product, NASA will collect a standard annual net royalty fee. The technologies available for licensing have been vetted for technical and commercial viability, and the patents are maintained by the government. NASA technical personnel and facilities can be made available to companies to lend additional support if needed.

Companies entering into these startup licenses are bound by all requirements in Federal licensing statutes and NASA policies. For instance, they must develop a commercialization plan and periodically report their efforts to achieve practical application of the technology. The initiative provides nonexclusive licenses; however, NASA will consider negotiating exclusive licenses on an exception basis.

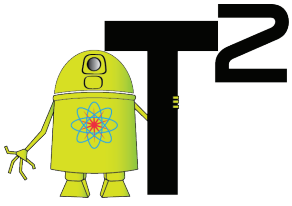
Companies interested in participating in the Startup NASA Program can find NASA patented technologies available for licensing at *technology.nasa.gov/patents*. The site also has a sample licensing agreement available for review. Once a company identifies a patent it wishes to license, it must complete and submit a licensing request form to *nasa-t2p-startup@lists.nasa.gov*. ▼

Swamp Works *Continued from page 7*

of the technologies under development is an electrodynamic dust shield (EDS) to prevent debris from accumulating on various surfaces such as spacesuits, thermal radiators, solar panels, optical instruments, and view ports. This technology works by creating an electric field that propagates like ripples on a pond across the material being protected. When the EDS system was activated during the reduced-gravity test flight, 99% of the dust was removed from the surfaces protected by the dust shields.

Future Work

Work on several other exciting technologies is also underway in the Swamp Works laboratories. The Dust to Thrust demonstration project involves the conversion of regolith into propellant that will be used to fire a thruster. The project also includes the development of regolith tolerant valves as well as quick disconnect fluid and electrical couplers and interfaces. In the robotics area, sensors with LIDAR, radar, and stereo vision are being investigated for use in helping robots maneuver safely in dusty environments. Robots are also under development for the production and deployment of pavers to create landing pads for rockets. Methods for sintering regolith to manufacture pavers and other materials are also being explored. In addition researchers are looking at how to use regolith for additive construction. This will involve extracting metals from regolith using molten regolith electrolysis, using regolith as a manufacturing feedstock, and voxel-based manufacturing using regolith and other *in situ* resources. ▼



Quinn Inducted into Florida Inventors Hall of Fame

Congratulations to Dr. Jacqueline Quinn of KSC's Exploration Research and Technology Programs Directorate (UB) for being inducted into the Florida Inventors Hall of Fame for her discoveries and inventions for environmental remediation. Dr. Quinn has several patents for inventions related to groundwater remediation and polychlorinated biphenyl (PCB) removal. Dr. Quinn's Emulsified Zero Valent Iron (EZVI) technology for the removal of dense nonaqueous phased liquids (contaminants) from groundwater has been licensed to more companies than any other patented technology at NASA. She recently received funding to optimize a technology for the removal of PCBs from sediments. This new technology, known as SPEARS (Sorbent Polymer Extraction and Remediation System), consists of rectangular-shaped frames into which ethanol-filled polymer spikes are mounted. (See the article on page 4.)

The Florida Inventors Hall of Fame encourages individuals of all ages and backgrounds to strive toward the betterment of Florida and society through continuous, groundbreaking innovation. The Florida Inventors Hall of Fame is located at the University of South Florida Research Park, Tampa. Honorees are selected annually through a nomination process open to all inventors in the state of Florida. The nominations are reviewed by a Selection Committee made up of distinguished experts in relevant fields of innovation. Nominees elected to the Hall of Fame are inducted at an annual ceremony, where their achievements are honored and their influence on society acknowledged and celebrated. ▼

Dr. Jacqueline Quinn

Tech Transfer Hosts Recognition Luncheon

The NASA KSC Technology Transfer Office held its Innovator Recognition Luncheon to celebrate KSC employee achievements. This luncheon was a thank-you to all who submitted a New Technology Report (NTR) in Fiscal Year 2015.

These NTRs covered a wide range of areas, such as development of microcapsule-based self-healing systems, an *in situ* method for producing launch/landing pads on other planets, and 3-D printing of shape memory alloys. NTRs are used by NASA to patent and commercialize inventions and new technologies developed by KSC scientists and engineers. Some of these inventions have been incorporated into common items we use every day. These technologies bring value to the country, prestige to the Center, and monetary rewards to the inventors.

In attendance were approximately 85 contractor and civil servant innovators, support staff, and VIPs, including KSC Center Director Bob Cabana and Associate Director Kelvin Manning.

The luncheon provided the opportunity to recognize those participating in the Technology Transfer Program. KSC TTO Manager David Makufka provided opening remarks and senior licensing specialist Lew Parrish presented insights on the inner workings of the TTO with a talk on "What happens after you submit an NTR." ▼

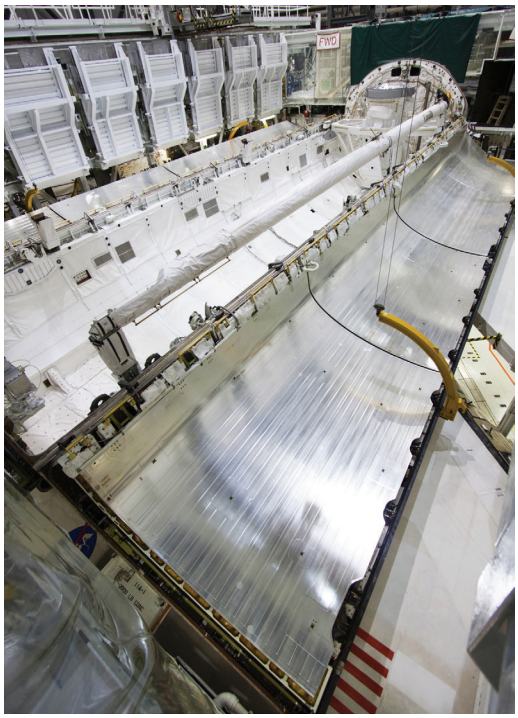
Youngquist Team Receives NIAC Award

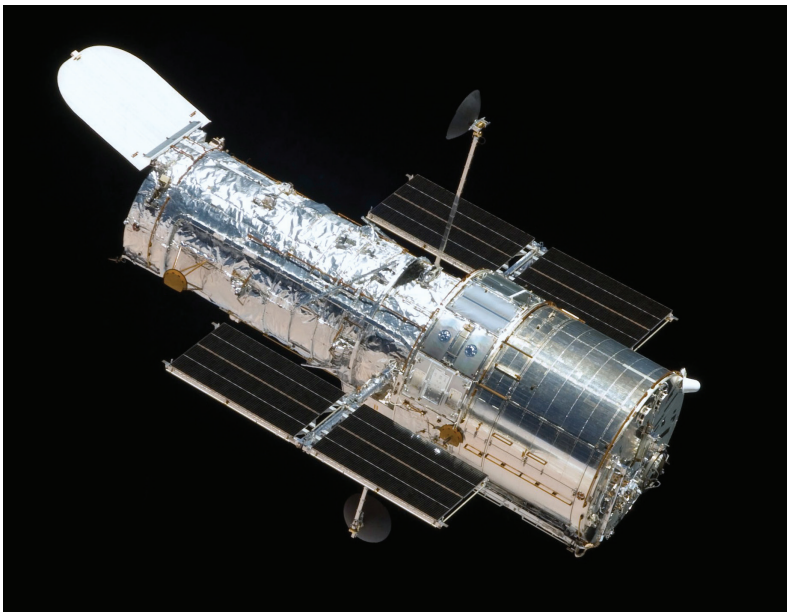
As NASA prepares to explore deep space, they will need to be able to store cryogenic commodities in the presence of the Sun. KSC's Dr. Robert Youngquist and his team are investigating an approach to accomplish this and recently were awarded Phase I and Phase II NASA Innovative Advanced Concepts (NIAC) awards for the research and development of a solution to this need. The NIAC Program nurtures visionary ideas that could transform future NASA missions with the creation of breakthroughs—radically better or entirely new aerospace concepts—while engaging America's innovators and entrepreneurs as partners in the journey.

Dr. Youngquist verified that cryogenic temperatures could be reached if a perfect selective surface coating could be found. Selective surfaces are material surfaces or coatings that have a wavelength-dependent emissivity. The goal of Dr. Youngquist's research is to find a surface that can work in deep space and achieve very cold temperatures passively. Theoretically, this can be accomplished by designing the surface to reflect more than 99% of the Sun's energy while emitting substantial infrared energy.

If the direction to the Sun is fixed, solar shields can be used to block solar radiation (as they do, for example, for the James Webb telescope). However, on a trip to Mars, the direction to the sun changes, and such an approach will not work. In addition, superconducting systems are desired, that currently require liquid nitrogen cooling. Both of these problems could be solved with a coating that rejects most of the solar energy and emits far-infrared thermal energy. Such a coating might not chill a heat-generating object, but would allow passive objects to reach cryogenic temperatures.

Dr. Youngquist and his team are investigating a selective surface coating that uses two layers: the first layer, a metallic surface, is covered by a second scattering layer made from one or more broadband transparent materials. The outer layer scatters most of the solar energy while the metallic layer reflects longwave solar radiation that gets through the scattering layer. By scattering nearly all of the solar energy, this coating appears white to most of the solar spectrum, i.e., a Solar White coating. Dr. Youngquist believes that by coating objects with this Solar White coating, cryogenic temperatures can be achieved in deep space. The space program needs long-duration cryogenic storage and operational superconducters and the proposed Solar White coating may be the enabling breakthrough for both of the needs to be met. ▼



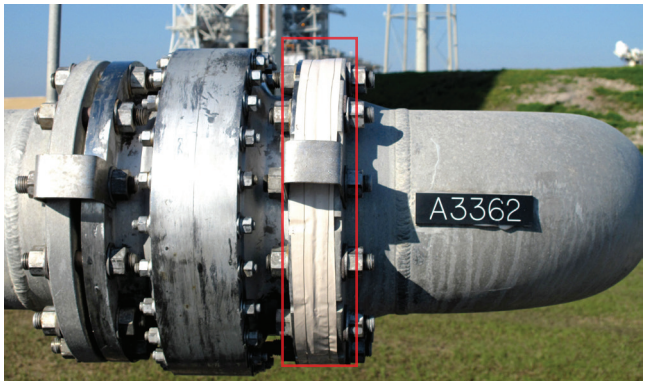


The selective surface used on the Orbiter Payload Bay doors to help control the temperature of the vehicle in space (left) and the selective surface used on the Hubble Telescope (above).

KSC Wins NASA's 2016 Commercial Invention of the Year

The Hydrogen Sensing Pigments in Manufactured Polymer Composites technology (aka Hydrogen Leak Detection Tape) was awarded the 2016 NASA Commercial Invention of the Year by NASA's Inventions and Contributions Board. The annual Invention of the Year program recognizes those inventions that have significantly contributed to NASA programs, or that exemplify NASA's mission to transfer cutting edge technology to U.S. industry.

The inventors of this patented technology are Luke Roberson, Janine Captain, Martha Williams, LaNetra Tate, and Trent Smith. Other contributors include Robert Youngquist, Mary Whitten, Robert DeVor, and Barbara Peterson. The winning invention is a chemochromic sensor for detecting a combustible gas such as hydrogen. It includes a chemochromic pigment mechanically mixed with a polymer and molded into a rigid or pliable shape. The technology is licensed to HySense Technology, which sells a product incorporating the technology, called Intellipigment.



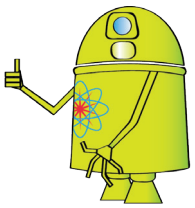
Hydrogen detection tape on the connector on the right can pinpoint the exact location of a link on this liquid hydrogen feed line.

Robert DeVor (right) looks on while Luke Roberson and Angela Krenn apply hydrogen detection tape on a connector joint on a cross-country feed line. The piping connected the liquid hydrogen storage tank with the lines to fill the shuttle's external fuel tank on launch day.

More Awards

KSC's Technology Transfer Office and the innovators of the Hydrogen Leak Detection Tape were also recognized at the 2015 Federal Lab Consortium's (FLC) Southeast Region meeting and received an award for Excellence in Technology Transfer Project of the Year. The FLC recognizes employees of its member laboratories and the nonlaboratory staff who have accomplished outstanding work in the process of transferring federally developed technology. Spread across nine states, the FLC Southeast Region is home to nearly 60 Federal laboratories and over 300 Federal facilities of the Departments of Defense, Homeland Security, and Energy; the Environmental Protection Agency (EPA); NASA, and other organizations. Luke Roberson, one of the inventors of the Hydrogen Leak Detection Tape, and Meredith Chandler and Mike Lester of the Technology Transfer Office, accepted the award.

And in 2014 the technology received an R&D 100 Award. Sponsored by R&D Magazine and widely recognized as the "Oscars of Invention," the R&D 100 Awards celebrate the top technology products of the year from industry, Government labs, and universities. ▼



Calle winner of Create the Future Design Contest

Drs. Carlos and Luz Calle attend the Tech Briefs award ceremony where Luz is featured on the cover of the magazine. Photo credit: Ellen Dubin Photography

NASA Kennedy Space Center Innovator, Dr. Luz Calle, won the 2015 Create the Future Design Contest in the Automotive and Transportation Category for her invention, Smart Coating for Corrosion Detection and Protection. The Create the Future Design Contest was launched in 2002 by the publishers of *NASA Tech Briefs* magazine to help stimulate engineering innovation. The annual event has attracted more than 12,000 product design ideas from engineers, entrepreneurs, and students worldwide.

Dr. Calle and her team from the KSC Corrosion Technology Laboratory developed a smart, environmentally friendly coating system for early detection and inhibition of corrosion and self-healing of mechanical damage without external intervention. This coating will have the inherent ability to detect the onset of corrosion in the coated substrate, and respond autonomously to control it. ▼

2015 Best of KSC Software

The Best of KSC Software award is designed to recognize outstanding software developed by KSC teams for the purpose of serving KSC. Software developed by civil servants or contractors is considered, providing there is a NASA intellectual property interest. Awards are grouped under two categories: institutional and outreach. Institutional software is designed to support and improve KSC business processes, and outreach software is designed to support public awareness of KSC's missions. The 2016 KSC Best of Software award ceremony will be held later this year. For more information on this award program, e-mail: *megan.e.victor@nasa.gov*. The 2015 winner was **Training Resource Automation Center**. The runner-ups were **Excavation Permit Request** (institutional category) and **Distributed Observer Network** (outreach category).

DON 3.1 has been selected as KSC's nomination for NASA's 2016 Software of the Year Award. Results of that competition will be announced later this Summer. ▼

Kennedy Tech Transfer News
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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.

Please send suggestions or feedback to the editor.

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TECHNOLOGY TRANSFER PROGRAM