National Aeronautics and Space Administration

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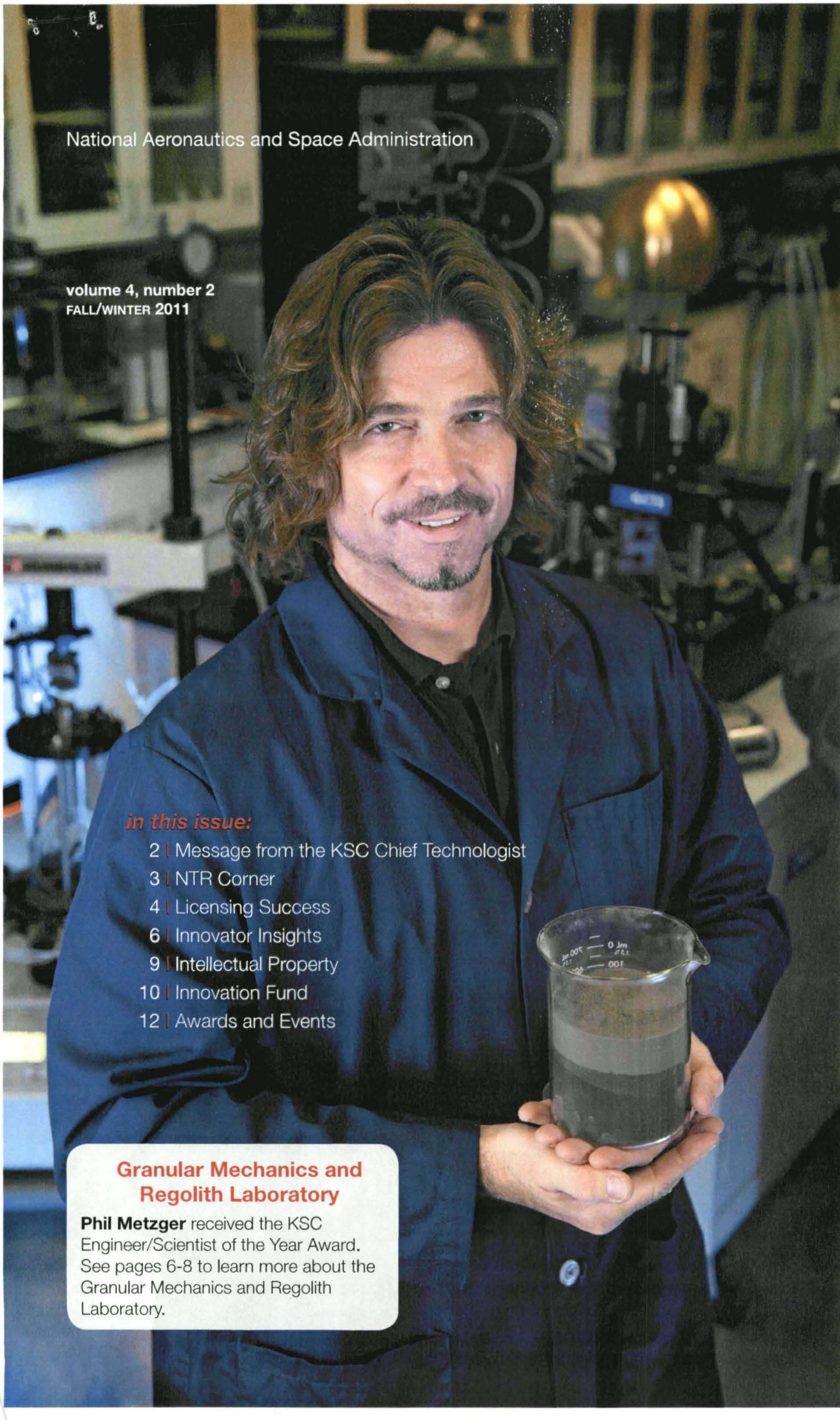
KSC NEWS

tech transfer



in this issue:

Granular Mechanics and Regolith Laboratory

Phil Metzger received the KSC Engineer/Scientist of the Year Award. See pages 6-8 to learn more about the Granular Mechanics and Regolith Laboratory.

A message from the KSC Chief Technologist

Karen Thompson

As the Chief Technologist of the John F. Kennedy Space Center, I view this as an exciting time in NASA for research and technology development. There is a strong focus on technology in our human exploration strategy and a focus on a wide range of technology readiness levels (TRLs) across all NASA missions – from low-TRL development of innovative technological concepts that help reposition NASA on the cutting edge, to infusion of technology to solve critical mission needs. Throughout the TRL spectrum, there is a major emphasis on partnerships with academia, industry, and other Government agencies and among NASA Centers.

This strong focus in research and technology helps NASA balance three long-standing core competencies that go back to the Space Act and the formation of NASA. These three core competencies are research and technology development, flight hardware development, and mission operations. The synergy of these three core competencies makes NASA unique and is the reason NASA is so inspiring to young people. Without the research and technology competency, we can only take a rather incremental approach to flight hardware development. We can be much more successful if we are able to conduct what many refer to as "disruptive technology development," which enables major advances. A number of external panels, including a recent National Research Council committee, have reported that, over the past decade, research and technology at NASA have been almost wiped out and need to be reinvigorated. A healthy NASA on the cutting edge should be strong in research and technology, in spaceflight hardware development, and in mission operations.

NASA's human exploration goals will require a whole host of technology development and demonstrations. We must design architecture to reduce the cost and improve our capabilities for future exploration systems. We will need technologies such as heavy-lift propulsion technology, in-space propulsion technology, robotic precursors to some of the destinations where we want to send humans, technologies to enable lengthy human stays on Mars, and ground systems and operations to get us to exploration destinations at a greatly reduced cost. In addition to the human exploration program are other parts of the technology development program across NASA. Important to NASA technology goals is involvement of NASA Centers, academia, other Government agencies, and industry.

NASA's budget request is aligned with the national strategy, which has a renewed emphasis on research, technology, and innovation for the nation as a means of stimulating the economy. NASA will gather research, technology, and innovation ideas from within NASA and outside NASA and will fund selected efforts with the goal of advancing many of the technologies to TRL 6 so that a mission would be willing to adopt it. Technologies will be infused into our future science and exploration missions and will also be infused into other Government agency missions and into industry.

KSC is especially adept at working collaboratively with partners from industry, academia, other NASA Centers, and other Government agencies. It is important for KSC to continue working such collaborative research and technology development efforts with excellence. We will see results of such work in the form of solving problems and enhancing our NASA missions while also providing societal benefits through infusion of our technologies into applications external to NASA as well. NASA performs an important role of technology transfer, with many examples shown in this newsletter. ■

New Technology Report (NTR)

Technology Title: **Aluminum Foam Heat Exchanger for Cold Helium Production**

Inventors: **Brian M. Hunter, Jared P. Sass, and Walter H. Hatfield**

Case #: **KSC-13452**

What it is: Engineers at Kennedy Space Center's Cryogenics Testing Facility have developed an aluminum foam-based heat exchanger to produce cold supercritical helium. The heat exchanger is small, modular, and reliable. It has no moving parts, and each module consists of two channels filled with compressed aluminum foam that is brazed along the length to either side of a 1/2" thick aluminum slab – one side for high-pressure helium and one for cryogenic coolant. A helium pressure control and flow control system effectively regulates the helium mass flow. The novelty is using aluminum foam in a cryogenic heat exchanger.

In operation, liquid hydrogen or another cryogenic fuel flows into one side of the heat exchanger. Ambient helium enters the other side of the heat exchanger in a counter-flow configuration. The architecture of the foam optimizes the surface area to enable a very high heat flux.

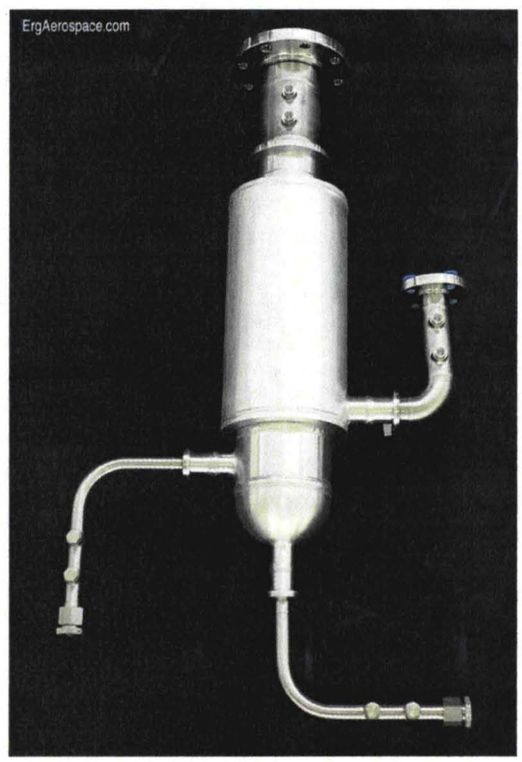
> "This smaller, lighter, less expensive heat exchanger is a promising innovation for space applications."

Why it was needed: NASA developed the heat exchanger for the new generation of heavy-lift vehicles, which require cryogenic helium to be generated at the launch site to pressurize the vehicle's fuel tanks. Two prototypes of the heat exchanger have been developed and tested by innovators Walt Hatfield, Jared Sass, and Brian Hunter. A smaller version has been tested using liquid hydrogen, liquid nitrogen, and liquid helium as a coolant. A larger version was tested at Plum Brook Station, a remote test installation site for the NASA Glenn Research Center, where engineers perform complex and innovative ground tests for the United States Government (civilian and military), the international aerospace community, and the private sector.

What makes it better: The most appealing feature of the heat exchanger is its small size compared to the heat exchangers that NASA used previously. The smaller size allows the heat exchanger to be a point-of-use device so that the helium can be produced on site, minimizing transmission losses. Weighing in between 80 and 100 pounds, the new heat exchanger is much lighter than traditional designs, and theoretically, three modules do the job that a 20,000-pound pool boiler does. The cost of the heat exchanger is estimated to be much lower as well.

How it might be used: The heat exchanger will be relevant to the future heavy-lift vehicles developed by NASA and commercial aerospace companies. Other commercial applications exist in helium liquefaction and as thermal vent systems for satellites.

Tech transfer status: No patent application has been filed. This technology is still under review by the Technology Transfer Team. ■



Heat Exchanger

Launching a Small Business with NASA Shuttle Software

When the last space shuttle returned to Earth, the work performed by several thousand United Space Alliance (USA) specialists at Kennedy Space Center ended. Many of those affected by the end of the shuttle contract now face an uncertain future and the prospect of finding a new career path.

One enterprising USA employee affected by this situation decided to take matters into his own hands. Martin Belson, a mechanical design engineer and project manager, worked on the development and deployment of specialized software used by the Shuttle Program to generate repair instructions for maintenance technicians. This software, known as System Maintenance Automated Repair Tasks (SMART), captured repair instructions collected during 30 years of shuttle maintenance operations and provided the intelligence needed to select the appropriate instructions for a specific shuttle problem and organize them into a repair procedure for use by shuttle technicians. SMART greatly reduced the time needed to process a shuttle for its next launch, significantly improved repair procedure accuracy, and helped increase overall Shuttle Program safety.

Recognizing that SMART had potential in the commercial market, Mr. Belson approached NASA in spring 2011 about forming his own company and licensing the software. While he pursued licensing with NASA, he also worked with the University of Central Florida's Business Incubator Program to establish an office and base of operations. Mr. Belson's company, Diversified Industries C&IS, Inc., successfully licensed SMART from NASA on June 1, 2011.

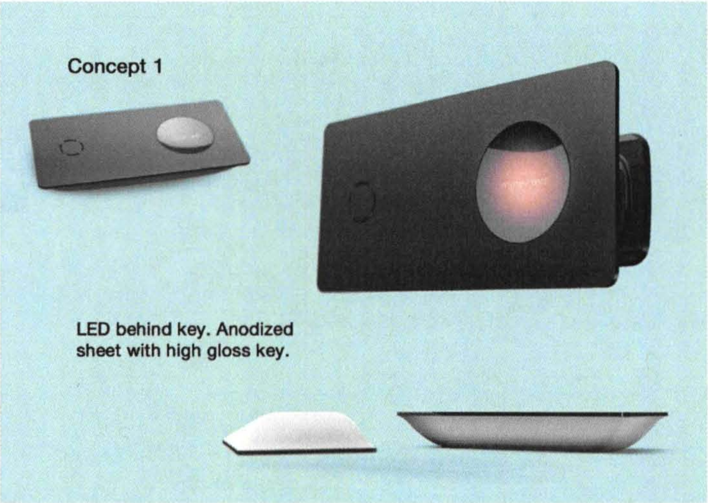
Once the license was issued, Diversified Industries C&IS, Inc. hired employees and developed its own version of the SMART software for commercial use. The company is targeting the maintenance, repair, and overhaul (MRO) sector as its primary customer for SMART.

Martin Belson – President and CEO of Diversified Industries C&IS, Inc.

Diversified Industries C&IS, Inc. is an excellent example of how NASA-developed technology can be used to create new business and job opportunities. While forming his business, Mr. Belson reached out to original members of the SMART development team and brought some of them on board to add their knowledge and expertise to his company. Thus, a NASA-developed technology not only provided Belson the opportunity to create a business, but also helped bring other displaced shuttle workers back into the workforce.

Diversified Industries C&IS, Inc. is located at 3251 Progress Avenue, Suite A, Orlando, FL 32836. More information about the company can be found at the following URL: *http://diversifiedindustries.biz/*. ■

Aviation Technologies and the Personal Cabin Pressurization Monitor



Hypoxia results from unprotected exposure above certain altitudes. Defined as an insufficient supply of oxygen to the body's tissues, hypoxia insidiously affects the central nervous system and organs. The most dangerous aspect of hypoxia is that the victim may lose the ability for critical judgment before detecting any impairment. Hypoxia is particularly dangerous for an aircraft crew when there is a slow, progressive increase in altitude or a sudden exposure to high altitude.

NASA's Jan Zysko, an engineer at Kennedy Space Center, developed the personal cabin pressurization monitor, a personal safety device that alerts the user to dangerous or deteriorating cabin pressure, which could lead to hypoxia, based on the limits prescribed in the Federal Aviation Regulations. The technology alerts the user when a programmed cabin pressure altitude is reached, or 30 minutes between the two altitudes. NASA applied for and received a U.S. patent on the invention. The invention also received several awards, including NASA's Invention of the Year in 2004.

Aviation Technologies, of Del Mar, California, has recently licensed the patent from NASA. The company is developing a basic 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 cabin pressure is approaching or exceeds a maximum safe operating altitude. The monitor has a sleep mode and will only "awaken" and sound when pressure is outside the safe limit. There are plans to develop an enhanced Pro model based on market demand and customer feedback. The initial model will be introduced to industry in 2012.

Aviation Technology has marketing connections within the aviation field, both commercial and private. In addition, they have a history of working with many successful aviation businesses at various locations around the world. Aviation Technology intends to market the Personal Cabin Pressurization Monitor within the industry to these before expanding to pilot supply companies, commercial airlines, and aviation schools. ■

Granular Mechanics and Regolith Laboratory

Phil Metzger, Ph.D., likes to remember the interns whose lives were changed by working in the Granular Mechanics and Regolith Lab. His first intern wasn't sure what she wanted to do with her life, but she had so much fun working in the dirt at Kennedy Space Center that she is now a Ph.D. candidate focusing on granular mechanics at the University of Colorado in Boulder. She is just one example. Phil thinks there is only so much work that we can do in our careers, but by influencing young people, we leave a legacy that goes on long after we retire. Recently, Kennedy Tech Transfer News visited with Dr. Metzger and learned of the lab's current projects, memorable successes, and work for the future.

What does the Granular Mechanics and Regolith Operations Group do within the Surface Systems Office?

The GMRO lab develops technologies primarily related to regolith – that is, excavation, conveyance (in and out of chemical processors), manufacturing and construction with regolith, site preparation, landing pad construction, prediction of rocket exhaust blast effects, etc.

Why is granular mechanics so important?

Almost every place humans can land in space is covered with regolith. We will need to land on it, drive on it, dig in it, build with it, extract resources from it, and study it for scientific information. In the inner solar system, regolith is primarily broken rock, such as silicate and basaltic minerals. In the outer solar system, the regolith is made of ice. However, the difference between rock and ice is a merely human definition – rock melts above our body temperature while ice melts below our body temperature; otherwise, they are the same. The regolith of Titan (the largest moon of Saturn) has sand grains, pebbles, and rocks, all made of solid-phase water, which are blown into dunes by cold nitrogen winds and washed along riverbanks of flowing liquid methane. In its mechanical behavior, this regolith performs just like sand grains, pebbles, and rocks on Earth.

The mechanics of regolith is arguably the last great unknown field in everyday physics. We have deep theoretical understanding of electromagnetics, fluid dynamics, optics, solid mechanics, quantum mechanics, stellar physics, and cosmology but no such understanding of granular mechanics.

Back row left to right: Michael Haddad, John Lane, Ph.D., A.J. Nick, Van Townsend, Jason Schuler, Drew Smith, Jim Mantovani, Ph.D. Front row left to right: Greg Galloway, Mike Csonka, and Phil Metzger, Ph.D.

How does your laboratory support NASA's overall mission?

Currently it is not possible to land humans on Mars for at least two reasons: entry and descent (slowing down a massive, fast-moving vehicle in the very thin Martian atmosphere), and landing (preventing the plume of a powerful, 40- to 60-ton vehicle from digging a deep unstable crater that can't support the lander). We work on that terminal landing problem – how to predict and mitigate the cratering effects – and the challenge of making space missions more affordable by processing resources from the regolith rather than launching and hauling everything from Earth.

Can you explain some of the societal effects?

Because Mars is so far from Earth, the methods to process resources must be robotic and autonomous. Once we can excavate, process, and manufacture with space resources autonomously, possibilities open up, like constructing beamed power systems to help solve world energy problems, or building habitats and scientific outposts in space to understand the universe we live in. It is possible to create a self-expanding system where robots build more robots entirely from space resources and energy – and I believe that future is really not that far off. Perhaps we can do this within 30 years if we get started right away. Once we do that, then the billionfold greater resources of the entire solar system become available to human civilization, and it is hard to comprehend what a revolutionary effect that will have upon mankind.

Why is it important to understand extraterrestrial environments and, in particular, granular materials?

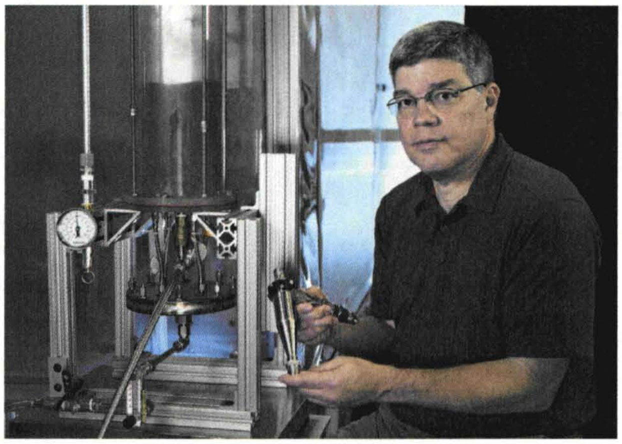
Regolith is very important as a resource for human activity wherever we go. On the Moon, almost all the resources are contained in the regolith (since the atmosphere is so thin). On Mars, the regolith contains frozen water beneath some distance, depending on latitude. In addition to its importance as a resource, we want to understand planetary geology. The record of the planets' geological histories is stored in their regoliths, so we need to be able to take core samples and to dig deeply beneath the surface. There is also an important matter of protecting planet Earth. Someday we may discover an asteroid on a collision course with the Earth. If we have enough time, we might attach a thruster to the asteroid to push it out of the way. But how do you attach a thruster to a spinning object that is a rubble pile of rocks and dust, held together only very weakly by its own gravity? Dr. Jim Mantovani and Dr. Laurent Sibille are working on a project for the NASA Innovative Advanced Concepts (NIAC) program to learn how to do just this, including the chemistry of converting the solid regolith into the thruster's propellant. So the mechanics of regolith in ultralow gravity may one day be important to the survival of life on Earth.

How will NASA use your research?

I am working with Rob Kelso of Johnson Space Center to understand how to protect the Apollo, Surveyor, and other sites on the Moon from the sandblasting effects of visiting landers. Right now we are publishing a set of guidelines on how to land near these sites with minimal sandblasting. Dr. John Lane has developed the software that we are using to develop these guidelines.

We are also developing a variety of hardware that is being taken out to NASA's analog sites for large, integrated field tests, which helps to mature the technologies and get them ready for upcoming missions. For example, Van Townsend and Dr. Jim Mantovani have developed methods of conveying soil and have worked with others at KSC to test them in reduced-gravity aircraft, and these technologies are being taken to field sites, such as Mauna Kea in Hawaii, as part of the *in situ* resource utilization (ISRU) field campaigns. Jason Schuler, A.J. Nick, and Drew Smith are developing excavators, including lightweight carbon composite excavator blades to go on the Lunar Electric Rover, percussive digging buckets to dramatically reduce digging forces in low gravity for Jet Propulsion Laboratory's six-legged robot/rover ATHLETE, and the automated Quick Attach mechanism so that space vehicles can quickly pick up and transport a variety of items at their destinations. They also developed a mini-excavator called RASSOR, which can work in very low gravity to deliver regolith to chemical processors. Gabor Tamasy and Van Townsend have been developing methods to automatically mate and demate umbilicals and keep them dustfree, which is a huge technology challenge.

We also partner with the KSC Education Office and NASA Headquarters to host the annual Lunabotics competition. Greg Galloway has been developing the Lunarena with 60 tons of artificial lunar soil to simulate the lunar environment. We are preparing for the third annual event, and it has grown in scope and excitement every year. Last year, 36 college teams competed with robotic excavators – Lunabots – that they developed and brought to the Lunarena. This year over 40 teams are registered so far, and the event is still months away. NASA supports this event to develop future technologists, but also to help us learn how to operate on the Moon. We have learned a lot from the efforts of these students.



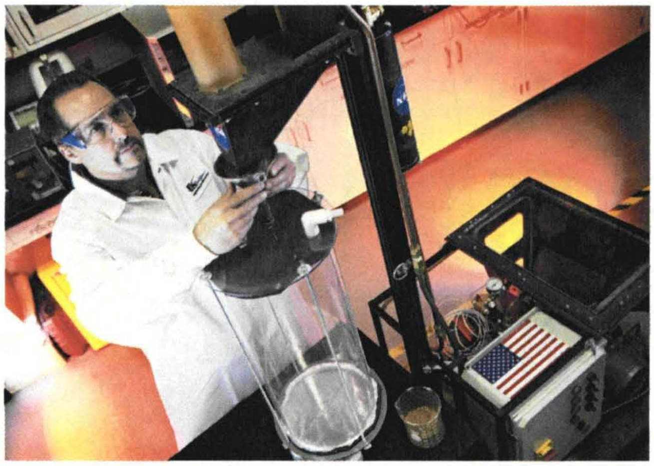
James Mantovani, Ph.D.

How has collaboration with other groups helped your research?

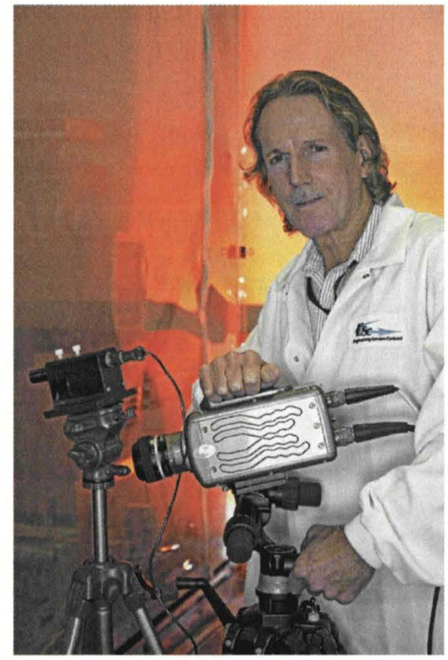
We work with a wide variety of universities and corporations, including large and small businesses, as well as every other NASA Center. We are currently working with Caterpillar to develop autonomous mining methods. It would be impossible to list all the collaborators who have made very large contributions in regolith mechanics and technologies. Sometimes collaborators come to KSC to work with us. Other times we hand off a project and they deliver the technology to us. Other times we work hand in hand, visiting their site to work and test the new devices. We travel with them to field sites for more testing. We work with students and faculty in reduced-gravity flights. We host interns and summer faculty fellows in our lab regularly. We use every method we can imagine to harness the energies of all the fantastic, enthusiastic people who come our way.

How has the Tech Transfer Office helped your research?

The Tech Transfer Office is a regular part of what we do. We are in the business of developing new technologies, and so we are constantly writing New Technology Reports to document them. The Tech Transfer Office then decides whether a technology needs further investigation to pursue a patent or commercial development. We don't have the time to do this ourselves, so we appreciate the thorough job Tech Transfer does. Sometimes their reports identify potential collaborators. Sometimes they point out the weakness of an invention and show what it needs to capture interest outside NASA. And that sets the bar for future work.



Van Townsend



John Lane, Ph.D.

What are some of the unique technologies that you are working on?

Rob Mueller is the Lunar Destination Co-Lead on the Human Spaceflight Architecture Team, or HAT. He is helping to understand how to apply these and other technologies toward future missions in the solar system. He is also working with Dr. Michael Hogue and with Ames Research Center to develop a heat shield made out of dirt. You can make this heat shield robotically in Mars orbit, using regolith from Mars' moon Phobos. Then a spacecraft from Earth rendezvouses with the heat shield, straps it on, and descends. Just building the heat shield near Mars rather than bringing it from Earth may dramatically reduce the cost of a Mars mission. This is a NIAC project that just got started. Rob and Mike came up with the idea by asking "What else can we do with regolith?" It might just be dirt here on Earth, but in space it's a valuable resource. ■

The Leahy-Smith America Invents Act

President Obama signed the Leahy-Smith America Invents Act into law on September 16, 2011, thus overhauling the uniquely American patent system from a first-to-invent system to a first-inventor-to-file system. This change aligns U.S. patent law with that of the rest of the world. Several changes will significantly affect the way intellectual property is protected, two of which will be discussed: (1) first-inventor-to-file and (2) changes to the novelty rules under 35 USC §102 ("Section 102").

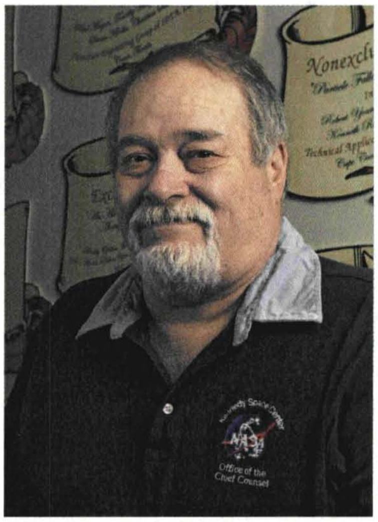
The shift to a first-inventor-to-file system is the foundation of the America Invents Act. Gone will be the days of filing sworn affidavits during the prosecution of patent applications to document when an invention was conceived. These affidavits were used to establish an earlier date to circumvent prior art references, as well as to resolve interferences between two or more applications filed within 1 year of each other. The earliest date inventors will be afforded under the new system will be the effective date (i.e., actual filing date) of the patent application.

Along with changing to a first-inventor-to-file system is a complete overhaul of the novelty rules under Section 102. The old Section 102(a) vanished in the Act and, along with it, the concept that prior art must precede the date of invention. Gone too is Section 102(b) and the 1-year statutory bar against filing for patent protection if the invention was disclosed publicly, in use, or on sale more than 1 year before the application filing date. When the Section 102(a) goes into effect (18 months from the signing of the bill), a variety of things (e.g., patents, printed publications, public uses, and the offering of an invention for sale) that predate the patent's effective filing date will constitute prior art. A new category of potential prior art includes information available to the public that describes the invention.

This new rule comes with a major exception: prior art does not include disclosures made within 1 year of filing if "the subject matter disclosed had, before such disclosure, been publicly disclosed by the inventor or a joint inventor or another who obtained the subject matter disclosed directly or indirectly from the inventor or a joint inventor" (see new Section 102(b)(1)(B)). In other words, inventors will be able to disclose their inventions in an unrestricted manner, not subject to nondisclosure agreements (often the only way potential investors operate), and still file a patent application within 1 year. This provides the inventor with essentially a 1-year grace period in which to seek financing to commercialize the invention before having to file a U.S. patent application. However, if the inventor delays in filing an application while seeking such financial support, the inventor may not be the first party to file a patent application. As a result, under the new rules, the inventor will ultimately lose the right to obtain patent protection. A cost-effective way for the inventor to protect the invention while searching for investors is to immediately file a provisional patent application. This allows the inventor to seek financing with a minimum expenditure of funds. Within 1 year of the provisional filing date, an inventor must file a full nonprovisional patent application to protect the invention and ultimately obtain a patent. The filing of provisional patent applications will become increasingly important to protect an inventor's ability to obtain a U.S. patent in the first-inventor-to-file world.

This new provision has the potential to encourage early disclosures of information by the inventor because the disclosure would operate as prior art against the rival's patenting attempts under the new Section 102(a). Rather than a race to invent and file first, perhaps this will produce a race to engage in early public disclosures. Unfortunately, disclosures and subsequent patent filing will only apply to applications filed in the United States due to the lack of a self-disclosure exception in many countries. Once an invention is disclosed in the United States, there is an absolute bar against later filing for patent protection in many foreign countries.

It is not yet apparent how the America Invents Act will affect the way we protect intellectual property, but the effects are likely to be significant. We will continue to analyze the changes to the patent laws and amend our practices as necessary to be prepared for the major changes when they take effect on March 16, 2013. ■



Randy Heald, KSC Patent Attorney

NASA Innovative Advanced Concepts

The Center Innovation Fund (CIF) was established by the Office of the Chief Technologist (OCT) to stimulate and encourage creativity and innovation in addressing the technology needs of NASA and the nation. CIF projects are managed by the Center Chief Technologist. CIF projects were selected based upon the following criteria: innovative (high-risk/high-payoff concepts), relevant to NASA and national needs, collaboration (inside or outside NASA), and capable of achieving significant progress by the end of the 1-year performance period (advancement of Technology Readiness Level [TRL], significant lessons learned, potential for follow-on work).

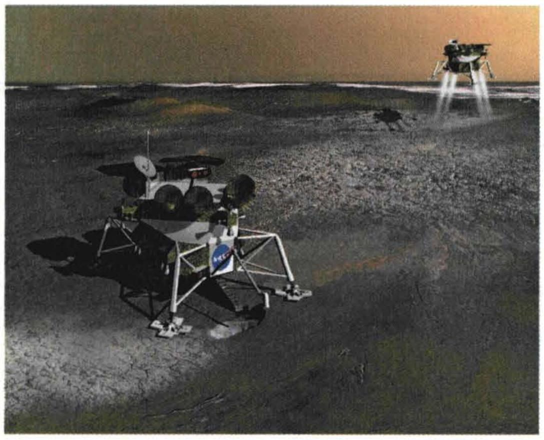
The following CIF projects were awarded at KSC for 2011. These projects align with KSC's technology needs.

2011 Center Innovation Fund Projects

- Look-Down Sensor for Soil Erosion
- Nonspherical Microcapsules for Increased Core Content Volume Delivery
- Protein Colloidal Aggregation
- Regolith-Derived Heat Shield for Planetary Body Entry and Descent System with *In Situ* Fabrication
- Far-Field Electromagnetic Tractor Beam
- Visible-Light-Responsive Catalyst for Air and Water Purification
- Wireless Multiplexed SAW Sensors
- Switchable Architecture Materials/Systems for Both Conduction and Insulation

The object of the NASA Innovative Advanced Concepts (NIAC) Program is to inspire and nurture revolutionary concepts that could transform future aerospace endeavors. The development of advanced and innovative aerospace technologies is critical to meet our goals for exploring space and understanding the Earth, our solar system, and the universe. To this end, the OCT, under the Early Stage Innovation Program, released a NIAC solicitation in March 2011to seek innovative low-TRL research projects to meet NASA's exploration goals.

For 2011, KSC received 1-year NIAC awards for the following projects.



2011 NASA Innovative Advanced Concepts (NIAC) proposals awarded to KSC

- In-Space Propulsion Engine Architecture Based on Sublimation of Planetary Resources: From Exploration Robots to NEO Mitigation
- Regolith-Derived Heat Shield for Planetary Body Entry and Descent System with *In Situ* Fabrication

http://www.nasa.gov/images/content/595104main_sibille_full.jpg

In-Space Propulsion Engine Architecture Based on Sublimation of Planetary Resources from Exploration Robots to NEO Mitigation

Purpose of this NIAC Study: The objective of this study is to investigate the ability to access local resources on planetary bodies. These resources include materials found on asteroids, comets, terrestrial moons, and planets. They consist mainly of minerals but also contain ice of substances such as water and carbon dioxide. These resources will then be transformed into forms of power that will expand the capabilities of future robotic and human missions to explore planetary bodies beyond the Moon.

Power for Exploration Systems: The power used for deep-space probe missions is usually derived from solar panels for electrical energy, radioisotope thermal generators for thermal energy, or fuel cells and chemical reactions for chemical energy and propulsion. Ice is sublimated throughout the solar system. Carbon dioxide and water are ubiquitous under a variety of conditions, and their uses as gases offer a source of supplemental energy for space missions. Applications may include pneumatic regolith-conveying small attitude-control thruster, and NEO threat mitigation.

Planetary Resources: Materials found on the surfaces of asteroids, comets, and terrestrial moons consist mainly of minerals composed of metal oxides, but they also contain ices of substances such as water and carbon dioxide, all of which can be vaporized thermally into gases at moderate temperatures via low atmospheric pressure.

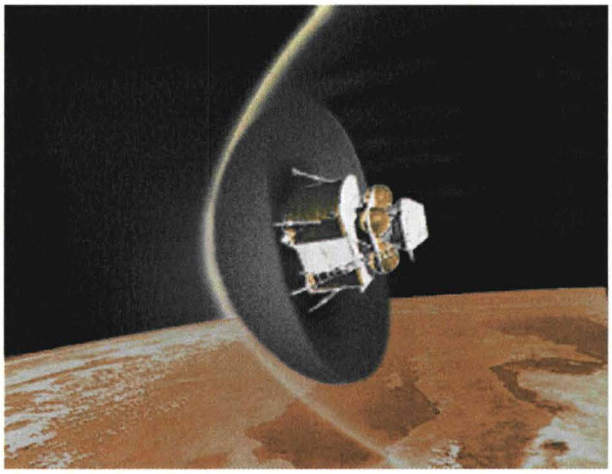
Phase 1 Goals: This initial NIAC study will focus on verifying the assumptions currently made about the properties of solid volatile ices found throughout the solar system and on demonstrating through experiments how much gaseous material can be produced from them to provide useful mechanical power for such activities as using actuators to lift objects and providing cold-gas propulsion.

This work will also investigate new engineering concepts for using the gasification of ice and mineral rocks found inside asteroids and comets in order to divert them from potential collision with Earth.

Regolith-Derived Heat Shield for Planetary Body Entry and Descent System with *In Situ* Fabrication

Introduction: High-mass planetary surface access is one of NASA's Grand Challenges involving entry, descent, and landing (EDL). Heat shields are heavy and costly to transport in space. The proposal is for a new mass-efficient and innovative way of protecting high-mass spacecraft during EDL. Heat shields fabricated *in situ* can provide a thermal-protection system for spacecraft that routinely enter a planetary atmosphere.

Purpose of this NIAC Study: During the entry and descent phase, frictional interaction with the planetary atmosphere causes heat to build up on the spacecraft, which can destroy it if a heat shield is not used. Instead of launching the heat shield from Earth, to avoid the extra mass and propellant requirements on the spacecraft, this project proposes to fabricate entry heat shields from the regolith of moons and asteroids. ■



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innovation fund

KSC Awards Manager and Editor of *KSC Tech Transfer News* Magazine Retires

Carol Anne Dunn is retiring after more than 26 years of distinguished NASA service at the Kennedy Space Center. During Carol's tenure as the KSC Awards Liaison Officer (ALO) from 2005 to her retirement in January 2012, she's championed more than 1,200 Space Act Awards resulting in over $850,000 in cash awards for 600 different KSC Innovators.

In addition to Space Act Awards, Carol helped bring recognition to KSC innovators and technologies through other prestigious awards such as the Federal Laboratory Consortium (FLC) for Technology Transfer's regional and national awards, NASA Invention of the Year and Software of the Year awards, and the Space Technology Hall of Fame awards.

In her other role as KSC's Technology Transfer Outreach Coordinator, Carol was instrumental in creating the *KSC Tech Transfer News* magazine and served as the chief editor since its inception in 2008. Carol also wrote numerous technology-related articles for other publications such as NASA's Innovation Magazine, ASK Magazine, NASA Tech Briefs, and FLC's NewsLink newsletter; and she developed the curriculum for the Introduction to NASA Technology Transfer training module.

In the years prior to 2005, Carol served as the paralegal to the KSC Patent Counsel and worked in the Vehicle Engineering and Design Engineering organizations.

"Please join us in thanking Carol for her outstanding contributions to KSC's Technology Transfer Program and for helping to bring recognition and prestige to so many KSC innovators and technologies."

The Staff
KSC's Technology Transfer Office

TechXpo Conference

Mike Lester and Jeff Kohler from the KSC Innovative Partnerships Office attended the first annual TechXpo Conference sponsored by the Melbourne Regional Chamber of East Central Florida. The single-day event was created to allow companies with advanced technologies and innovations to display their products and services to other companies looking for technology resources and suppliers. The event was held at the Clemente Center on the campus of the Florida Institute of Technology in Melbourne. Company representatives and students at the event stopped by the NASA booth and received information on new technologies developed at Kennedy Space Center and educational programs offered by NASA. ■

Kennedy Tech Transfer News

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Kennedy Tech Transfer News is the semiannual magazine of the Innovative Partnerships 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.

Please send suggestions or feedback to the editor.

National Aeronautics and Space Administration

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