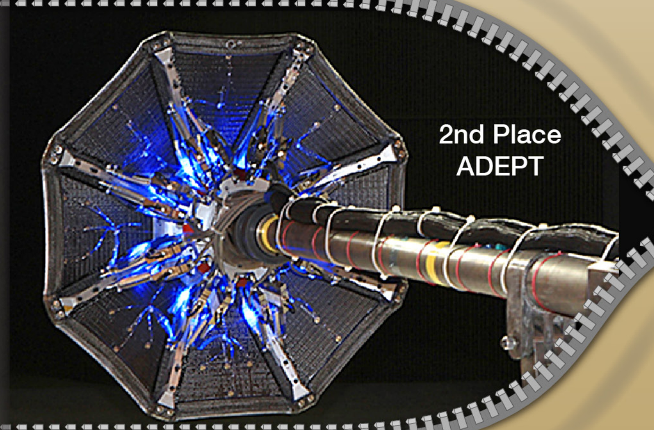
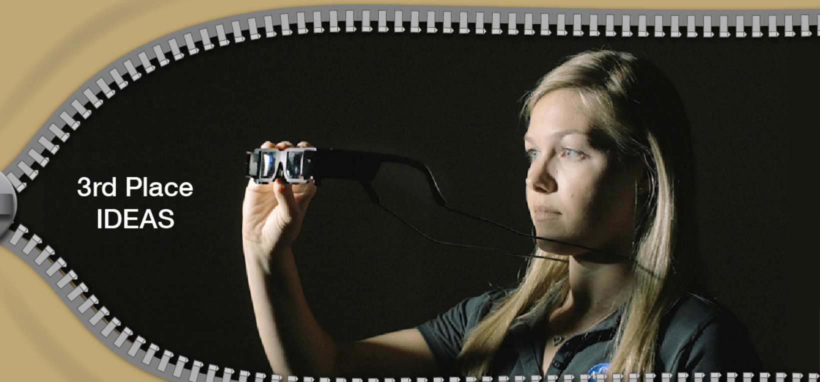
National Aeronautics and Space Administration

Space Technology

Game Changing Development Highlights





July-August 2015

Flexible Sealing Device Innovation Challenge Results
Resource Prospector Rover Makes its First Move
Robotics Testing on Astrobee and Robonaut

Image Contest Winners

We had another great round of photo submissions for our GCD Image Contest. I want to thank all the projects for participating this past fiscal year. We plan to use all of the images that were sent in some capacity.

It looks like members of the GCDPO staff have a soft spot for robots and babies. The image of R5 with a small child taken at the DARPA Robotics Challenge this summer garnered the most votes and is the contest winner.

Coming in second place is the Aeroloads Test image submitted by the ADEPT team. In this image, an ADEPT model with vibrant instrumentation is shown during a wind tunnel test.

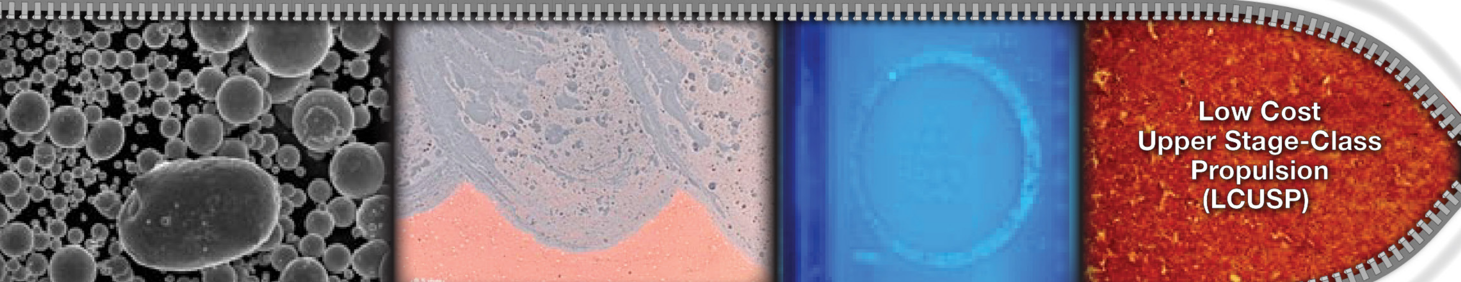
The third place image was submitted by the IDEAS project. In this picture, a team member is shown wearing the prototype glasses. A dramatic lighting effect really makes the image stand out.

“I feel like the image represents the project well as it shows the concept of using smart glasses for NASA and has an artistic, professional, look,” said IDEAS Project Manager David Miranda.

The Nuclear Systems project received an honorable mention for its Kilopower prototype test image. The photo shows the tops of the heat pipes glowing from the heat transfer.

The top three winning images are featured on the front cover, and the honorable mention can be seen to the left.

Kilopower




IDEAS
Advanced Radiation Protection
ADEPT
NGLS
LCUSP
Advanced Near Net Shape Technology
Materials Genome Initiative

Flexible Sealing Device Innovation Challenge Draws Mass Input

—Denise M. Stefula

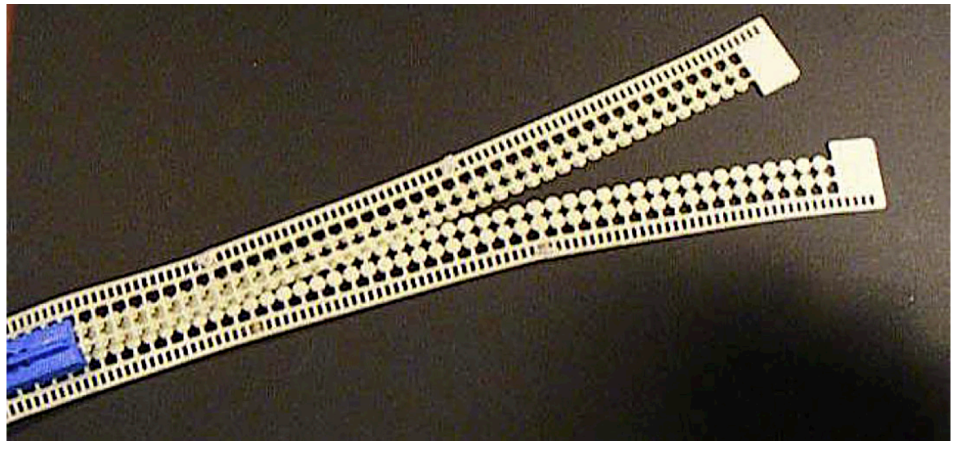
Synthetic setae material.
Synthetic setae materials are dry adhesive materials that can attach and detach repeatedly from surfaces without any loss of adhesion. Here, the GeckoSkin™ material pad is holding 300 pounds.

This year's InnoCentive challenge to design a lightweight, flexible hatch seal device to use in future inflatable airlocks and surface habitation modules concluded its award selection in July, ushering in four new technologies for possible advancement through NASA's Space Technology, Game Changing Development Program.

The development of a new flexible seal device will enhance the capabilities of future space missions by reducing mass and volume parameters. The objectives given were (1) to maintain air-tightness while the hatch seal is subjected to nominal pressure loads, and (2) to identify hardware components that enable easy open and close operations by an astronaut in a space suit.

The innovation challenge drew 448 solvers expressing interest and 109 actual proposals were submitted. After a filtering process, 83 proposals were sent to Game Changing's Minimalistic Advanced Soft Goods Hatch (MASH) project team for ranking with four seal device concepts selected for award: a modified zipper, an inner tube pair in a sleeve, a strip with compressed protrusions, and synthetic setae material.

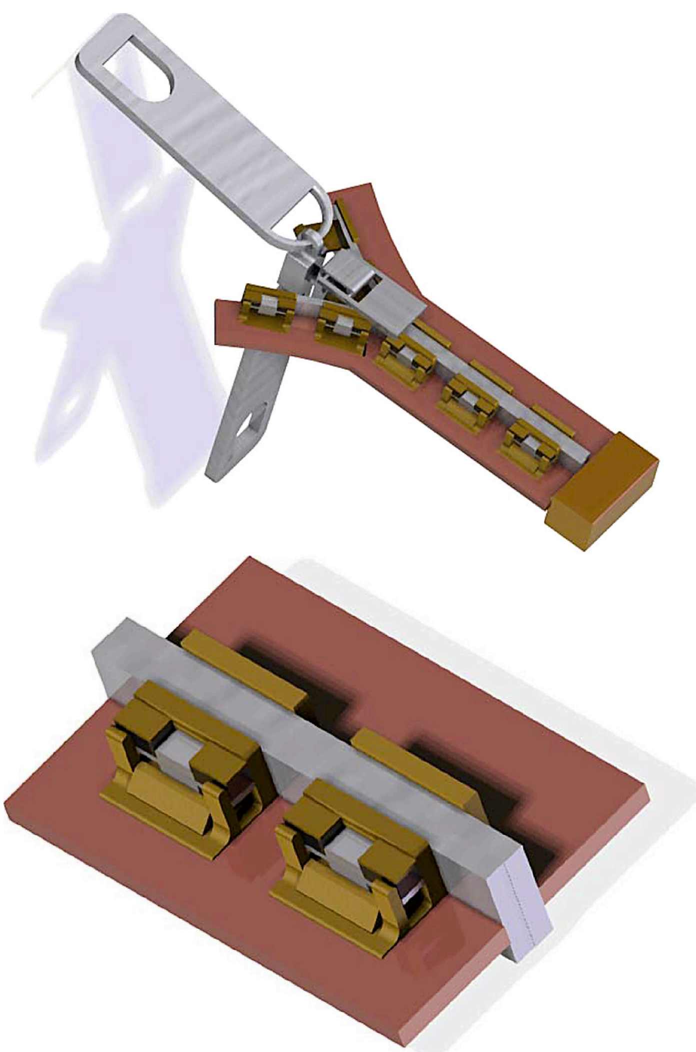
All awarded devices have easy to open and close mechanisms, redundant elements, and small stowage volumes. Proposals were sent from more than 30 countries and participants ranged from high school students to professional engineers.



Compressed protrusions.
The proposed device inserts a planar strip of dome-like protrusions into a mating receptor strip until the top of each protrusion engages its counterpart.

"I was first impressed with the number of proposal submissions," said Scott Kenner, deputy project manager for MASH. "And although all proposals didn't necessarily address all requirements, I was always impressed with some aspect of material or design creativity delineated in each proposal. The proposed solutions invariably exhibited the author's knowledge of physics, material science, or mechanisms."

The InnoCentive challenge solicits solutions from external non-NASA sources from around the world. A majority of received proposals attempt to professionally address and solve the specified technical problem. This new process of crowdsourcing for a technical solution is unique and very effective.



Zipper and zipper component.
The proposed device has a magnet and two interlocking members and is sealed and locked by pulling the translating handle and compressing the seal between the interlocking members.

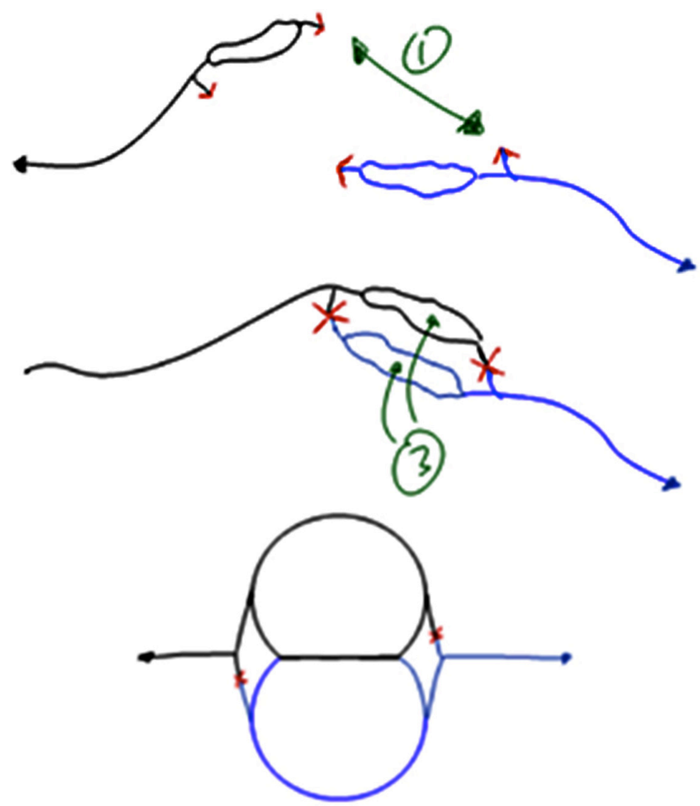
"The Innocentive challenge program is a reliable and productive external source for unique ideas and solutions that can help a project advance work in a specified technical area," said Kenner.

The MASH project has initiated plans to obtain a graduate student through an existing GCD grant program to work on dry adhesive Gecko materials, and the project plans to advance the design of a flexible inflatable tube concept through NASA Langley Research Center's model and fabrication shop.

"The technology readiness level advancement of these materials and devices will benefit the MASH project," said Kenner, "and one would anticipate elements of the inflatable airlock work will disseminate into future soft goods and inflatable structure designs across NASA."

Challenge results are announced on the InnoCentive website here: https://www.innocentive.com/ar/challenge/browse

All images submitted from the MASH team's proposal set and thus credited to NASA.



Inner tube pair in a sleeve.
The proposed device uses air pressure to compress two membrane tubes together within a confining sleeve, forming a hermetic seal.

Dateline June 2015—
Resource Prospector assembly and integration: battery installed and functioning—check. Power distribution running and powering payload systems—check. Wheel modules with gears installed for fit check—check. Software installed—check. Solar array/radiator installed—check. Mast on and successful mechanical deployment—check.

Dateline July 2015—
Resource Prospector surface element completes assembly and supports payload checkout—check.

Dateline August 2015—
Resource Prospector surface element prototype demonstrates first movement when HRS takes the rover for its first drive. Do we have movement? ***CHECK!***

Resource Prospector Prototype Takes Initial Test Drive

—Denise M. Stefula

The Human Robotic Systems' (HRS) rover technologies element that supports Advanced Exploration System's Resource Prospector (RP) Mission, RP15, successfully demonstrated mobility during initial testing on August 5 at Johnson Space Center in Houston, Texas.

"Our work during 2015 kick starts the progression toward flight," says Bill Bluethmann, project manager for HRS. "By conceptualizing, designing, assembling, and testing in a single year, the team made significant progress advancing our rover technologies toward TRL 6 before handing off to Advanced Exploration Systems (AES) for the flight work."

RP's first test drive proved it can function untethered and drive remotely, but getting there was a step-by-step progression. Bill explains that the team's problem-solving approach was to build a little, test a little, and then make incremental improvements.

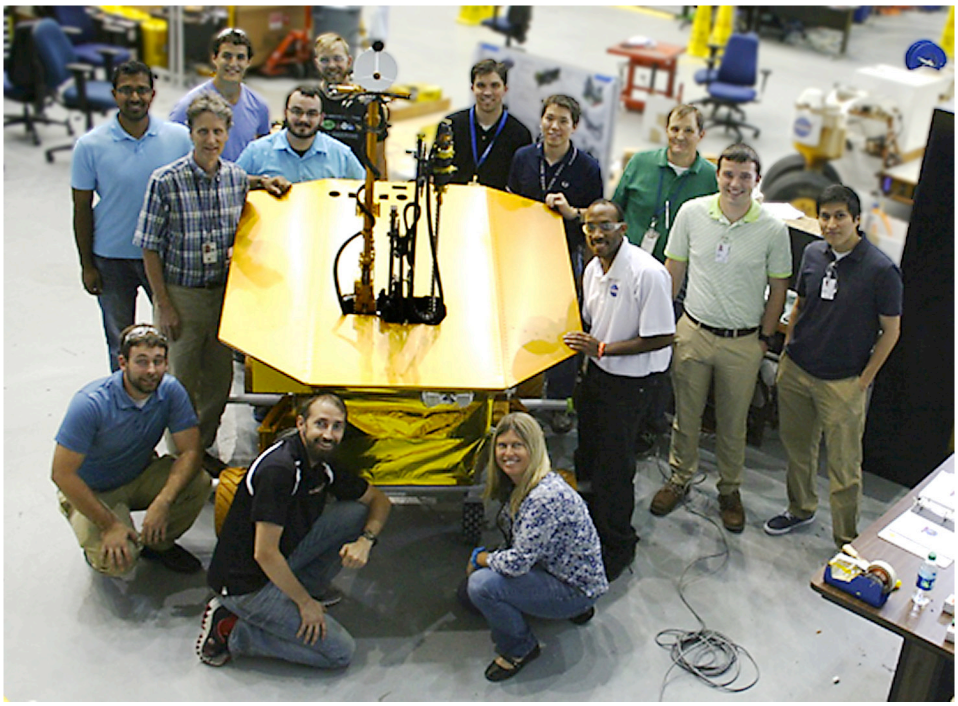
"During the rover's first visit to the JSC rock yard, the active suspension was not ready to be tested," says Bill as he shares an example of that methodology "The rover struggled during its initial climb of "Mount Kosmo", because the loads did not balance very well across the four wheels. The next day, the team updated the software/firmware and the rover drove right up the same hill it struggled to

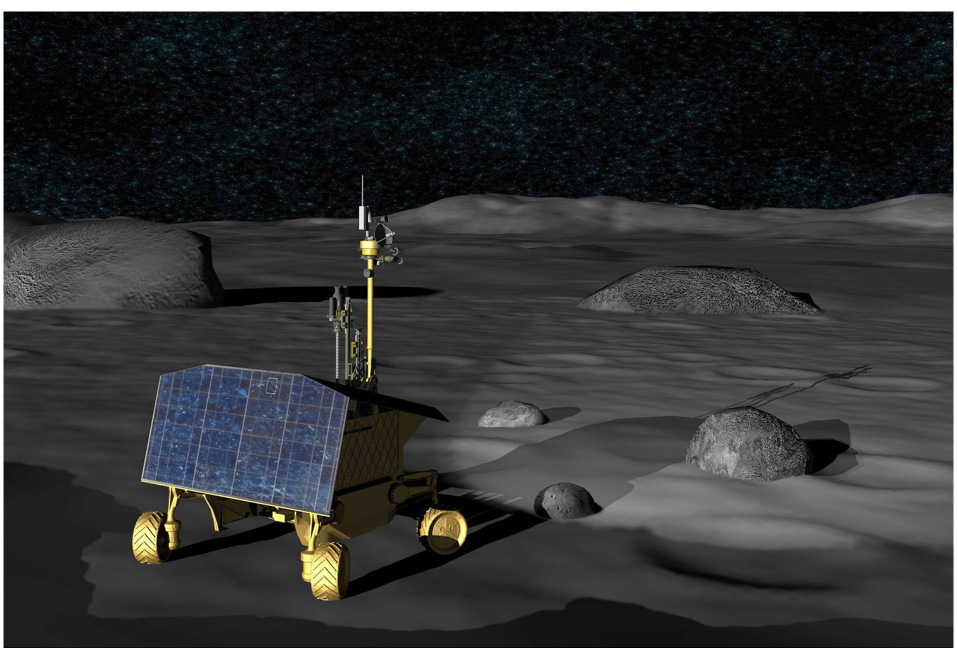
scale the previous day. The team worked extremely hard against a very aggressive schedule and we are all quite pleased with the accomplishments."

In addition to its mobility, the rover is integrated with the science payload and mission operations systems and completed two weeks of consolidated testing at the end of August. These tests involved remote driving from Ames Research Center, prospecting and processing lunar regolith simulant, and driving on rocky terrain with slopes up to 20 degrees. Further capabilities to be evaluated with the prototype include gravity offload testing in the Active Response Gravity Offload System.

"The goal of the 2015 plan was to build mobility, with outdoor testing with the Resource Prospector science payload in the JSC rock yard," says Bill "Next steps for the team are to continue advancing the technology through environmental testing at the centers, including thermal vacuum, shock/vibration and gravity offload and continued development of readiness for the various systems."

Another thing pleasing Bill about the rover technologies work is what he describes as effective team efforts on many levels. "The partnership with the rover between the Game Changing Development (GCD) Program and AES is the model for how a technology program should interface with flight programs."





GCD and HRS are developing rover technologies to TRL 6 and then transitioning them to AES for flight development.

Many of the technologies within the rover are new and game changing, including the active suspension, the offset crab steering, and the approaches for controlling remote systems over intermediate (<30 seconds) time delay.

"Resource Prospector is important because recent missions have identified volatiles (in water-ice) at the lunar poles," says Bill. "The RP Mission seeks to determine the distribution of these volatiles both across the surface and at depth."

The ultimate goal for RP15 is to progress toward performing in situ resource utilization on the lunar surface that will potentially enable the creation of a fuel depot using these volatiles.

Facing page: The rover perches atop "Mount Kosmo" rock yard at Johnson during its first test drive.

Top Left: The team poses with the rover prototype while readying it for first movement scheduled in July.

Left: Concept for the Resource Prospector rover.

HET-2's Summer Busy with Astrobee Systems Testing

—Terry Fong/Chris Provencher

Astrobee, a new, autonomous free-flying robot for the International Space Station (ISS), has advanced one more step by reaching an important milestone. In July 2015, the GCD Human Exploration Telerobotics 2 (HET-2) project completed a set of subsystem tests with an Astrobee prototype in preparation for an ISS payload safety review. The tests, conducted over several months at NASA's Ames Research Center, focused on assessing the robot's navigation, perching, and docking functions.

Astrobee will serve as a zero-gravity, free-flying robotic test bed on the ISS equipped with vision-based navigation, fan-based propulsion, 3-D path planning, and a "perching" arm. Astrobee will also be capable of performing a variety of intravechicular activities (IVA) on the ISS, including providing mobile camera views for ISS systems flight controllers and payload controllers, carrying out mobile sound level surveys, and helping with radio-frequency identification-based inventory for ISS automated logistics.

"By performing such routine and repetitive IVA tasks robotically, Astrobee will help save the scarcest resource on the ISS—astronaut time—and allow the crew to dedicate more time to science and research," says HET-2 Project Manager Terry Fong. "Flight unit development will start in the fall of 2016, and launch to ISS is expected in the fall of 2017."

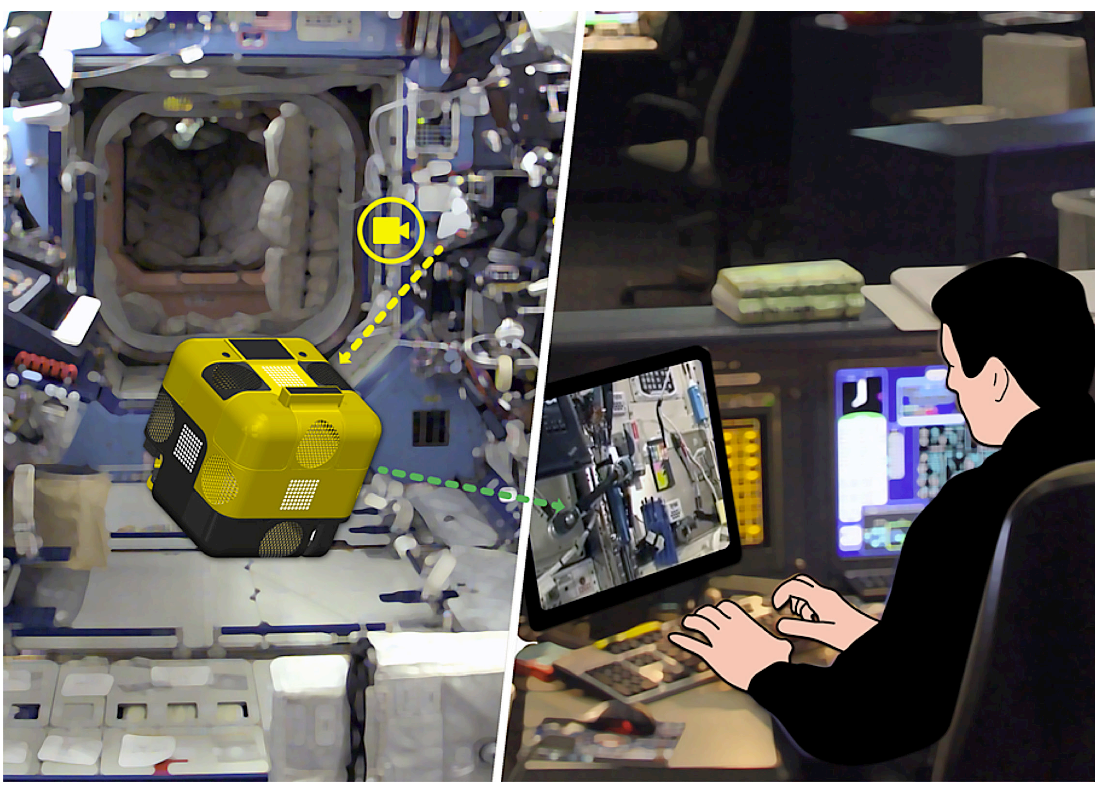
The navigation test focused on Astrobee's ability to navigate using unaided computer vision. In order to provide a variety of tasks for crew, the Astrobee needs to be able to navigate to any potential work site inside the ISS. To do so, it needs to be able to find its way around. Astrobee will use vision-based navigation to identify landmarks throughout the ISS, associate those landmarks with points on a map of the ISS, and use that map to navigate. Vision-based navigation is particularly challenging for a small robot with limited onboard processing power. Testing verified that the three main Astrobee processors were able to effectively manage all of the camera inputs, run the flight software, and calculate accurate position estimates.

The perching test was performed to characterize the gripping forces of the free-flyer's robot arm on IVA hand rails. In order to provide camera views of crew activities, Astrobee must be able to point its camera and then hold position for long periods of time. To avoid draining power by continuously using Astrobee's electric, fan-based propulsion system, the robot is equipped with a small "perching" arm. This will allow Astrobee to deactivate its propulsion system, save consumables, then use the perching arm to point the robot (and its cameras) as needed. Testing verified the ability of the arm to move the Astrobee around without losing grip on a handrail. Results from these tests will be used to optimize the gripper design over the next few months.

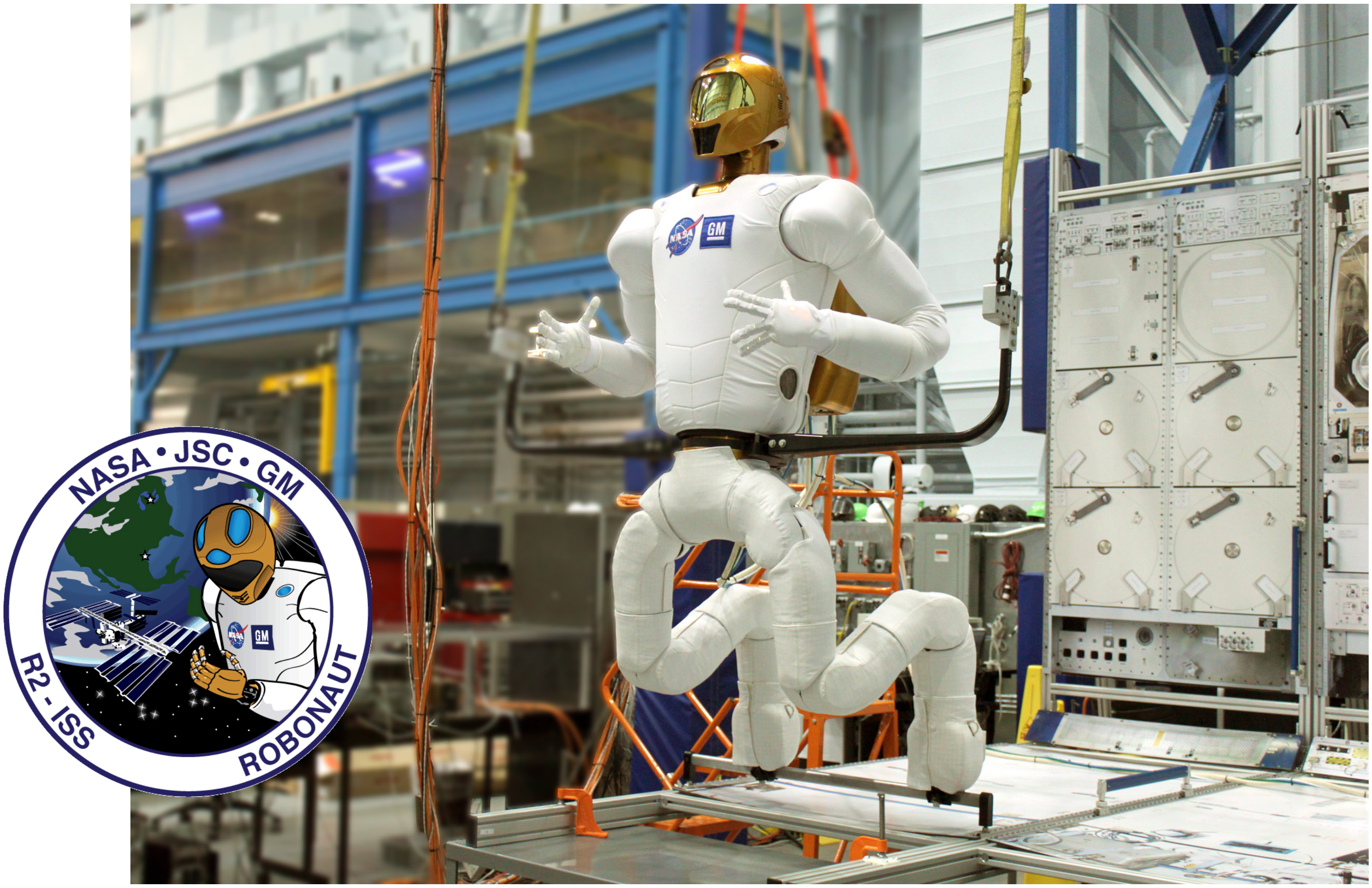
The docking test examined Astrobee's ability to navigate to the robot's docking station. The docking station is designed to provide Astrobee with a secure stowage location where the robot can recharge itself. To minimize crew time required for servicing the robot, Astrobee is being designed to autonomously approach, engage, and mate with the docking station. Testing verified the performance of the robot's docking navigation and control algorithms to perform these actions.

Astrobee Technical Lead Chris Provencher shared that the navigation, perching, and docking tests allowed the HET-2 team to verify overall the suitability of Astrobee's design, test the integrated avionics stack with flight software, address a number of subsystem risks, verify robot functionality and performance, and identify technical areas that need redesign or additional improvement. "The HET-2 project is employing an iterative prototype development and testing approach with Astrobee in order to identify design issues early in the project life cycle, as well as to methodically reduce risks."

Future human space missions in Earth orbit, to the Moon, and to distant destinations offer many new opportunities for exploration. However, astronaut time will always be in short supply, consumables (e.g., oxygen) will always be limited, and some work will not be feasible, or productive, for astronauts to do manually. Robots such as Astrobee, however, can complement astronauts by performing this work under remote supervision by humans from a space station, spacecraft, habitat, or even from Earth.



This conceptual design of a free-flying robot illustrates one of several tasks for which the eventual "Astrobee" will be capable. Astrobee's name was selected from a challenge announced during the October 2014 Comic Con held in New York City. Over 800 space fans submitted ideas for naming the robots and designing a mission patch.



R2 Goes Two for Two

—Julia Badger/Denise M. Stefula

The Human Exploration Telerobotics 2 (HET-2) project gains more ground advancing robotics technologies this July as two critical Robonaut capabilities realize internal project milestones: self-stow/unstow and obstacle avoidance on handrails.

Because Robonaut is an integration of multiple technologies, getting the combined functions synched up for a successful testing maneuver presents its challenges.

"It is difficult to develop and test these procedures on the ground due to gravity, which are very dynamic moves that cannot be simulated well in a stand," explains Project Manager Ron Diftler. "Simulations are helpful and were used to develop the early procedures, but certain things like using vision to find the specific handrail location to grasp is difficult to test well."

As it turns out, team members located at Johnson Space Center share a building with mock-ups of the actual U.S. Lab existing on the International Space Station (ISS). After discovering certain challenges in ARGOS, or Active Response Gravity Offload System, the team was able to take some data in the high fidelity mock-up that gave confidence in using a slightly different approach to resolving the problem that will work on the ISS.

Using a Robonaut (R2) testing prototype and ARGOS, the HET-2 team completed the maneuvers successfully—with integrated vision—corroborating by ground demonstration a future-planned on-orbit controlled milestone.

Above: R2 positioned in the ARGOS and undergoing testing of the self-stow/unstow procedure.

Self-stow/unstow

R2 'lives" in a rack on the ISS, and the Robonaut team is developing technologies and applications for R2 to put itself away when not being used. This skill is important to reduce crew time when astronauts need to employ the robot's capabilities for specific tasks and when that need has ended.

Space is a bit tight on the ISS, which means R2's overall design requires planning for both space constraints and the robot's functionality. To fit in the rack, some leg joints are located close to their joint limits, or how the joint can bend and move. Because vision-directed grasping of the handrails is used, these joint locations can restrict the utility of that autonomous function.

Joint limits

Noun | \'jȯint\ \'li-məts\
constraints and/or parameters in range and maneuver capabilities

"We had to adjust to make sure the robot starts this function far enough away from the limits and adjusts later," says Deputy Project Manager Julia Badger. "Also because of the tight space, we have to be really careful about how we get the joints to the correct positions, as these maneuvers can cause big motions. We had to advance some of our path planning and robot commanding technology to come up with a good way to address this challenge."

"Fortunately, the gravity offload system, ARGOS, can better approximate the conditions on the ISS," Badger continues. "Only challenge that we have with this test system is that the robot's upper body orientation must remain mostly fixed; on orbit, R2 will "lean" into the rack more in order to maintain room for other storage in the rack."

Obstacle avoidance on handrails

Researchers have been using vision processing to reliably attach R2's end effectors to handrails for climbing, so this technology added the ability for the algorithm to autonomously avoid areas of the handrail that are obstructed by things like conduits, cables or zip-ties.

"This is important because first, we don't want to potentially damage anything that may be close to handrails with R2's grippers, and second, it is very unlikely that R2's grippers would successfully grasp a handrail with any sort of obstruction in the way," says Badger. "The grippers are very carefully tuned to the exact width of a handrail due to our safety system."

The team's experience working with autonomous vision algorithms informs them when tackling an additional consideration: creating vision algorithms robust to lighting conditions, which is always a challenge and generally takes testing in many places to get it right. The algorithm used in testing originated in a lab using a gripper test bed, then moved on to the real robot in the lab. It was next tested on a different robot in the high-bay and finally in ARGOS.

"Adjustments to the algorithm were made at every step of testing, but our team was able to pin point the knobs needed to adjust the algorithm for the different conditions," says Badger. "We're confident that the overall algorithm will work on orbit, and we have the knobs available for tuning the algorithm as needed once we are able to test this technology in space. The team is very pleased with the test results."

Knob value

Noun | \'näb\ \'val-(,)yü\
deviation from the nominal value

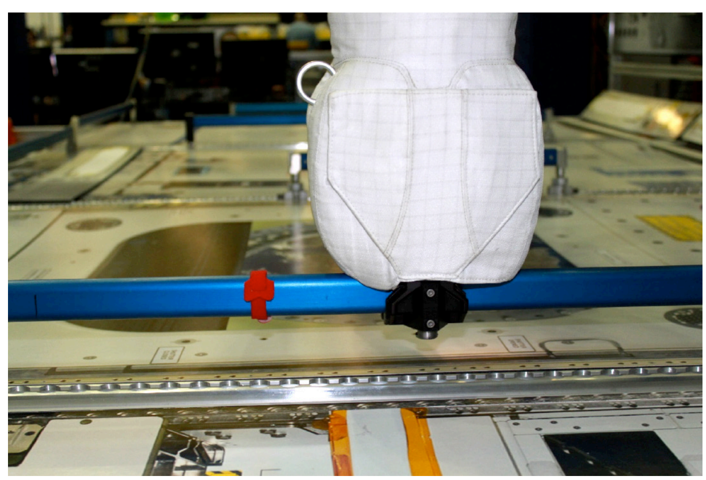
The bigger picture

The automatic stow/unstow capability is an important way to increase the utility of Robonaut onboard the ISS, which is the project's overarching goal. Obstacle avoidance on the handrail is one piece of the larger climbing technology goal and is an essential step to achieving that goal.

NASA identifies robotics and autonomous systems as a core technology indispensable for present and planned future missions. The HET-2 project plan for R2 describes its success criteria as developing robotic legged mobility to a technology readiness level (TRL) of 6, autonomous task software, and computer vision.

When asked what TRL robotics under HET-2 should be classified as being in right now, Badger admits it is a difficult question to answer.

"The field of "robotics" is such a broad one," she explains. "We're working on getting to a TRL of 6 specifically for climbing using path planning, autonomous vision, and ad-



Close-up of R2's end effector with gripper attached to a handrail near an obstacle that was successfully avoided during testing.

vanced commanding interfaces, and will achieve that by the end of the fiscal year. To do this, the Robonaut team has sought out fundamental research in different robotics fields and worked hard to apply this research to the R2 system in order to reliably achieve tasks."

Small crews in complex spacecraft or habitats will need assistance in maintaining systems in order to achieve important scientific mission objectives. The climbing task is an essential skill for any spacecraft-tending robot in microgravity, and applies to both ISS intra- and extravehicular activities and any future exploration spacecraft while en route to its destination.

"Robonaut is game changing because it is a test bed that allows us to develop technologies needed for robotic systems for exploration in low-Earth orbit and beyond," says Diftler. "With its dexterous manipulation, advanced sensory capabilities, and sophisticated control and safety system, Robonaut is a great platform to conduct research into the robotic technologies important for future mission applications."

STMD AA Recognizes Game Changing Development Team Members

Image credit: NASA/David C. Bowman

On July 17, 2015, during his first visit to the Game Changing Development (GCD) Program Office and Langley Research Center as the Space Technology Mission Directorate's associate administrator, Steve Jurczyk presented recognition awards to several Game Changing team members. Here, GCD Program Manager Steve Gaddis accepts the STMD 2015 Leadership Award.

"I was genuinely surprised and humbled that someone thought enough of me to submit my name for this recognition," said Steve. "I was very happy and excited to receive the award, and in my mind, it is on behalf of the GCD Program Office. I believe that the Agency recognizes the great job this program's team has done."

Other award recipients recognized are:

Space Technology Award
Solar Array Development Team

Exceptional Achievement (Technical) Award
Michael Meador

Outstanding Performance (Institutional) Award
David Moyer, David Richardson

Leadership Award
Ethiraj Venkatapathy, Dr. Carolyn Mercer,
Dr. Daniel Barta

Innovation Award
Greg Zimmerli, Kendra Short

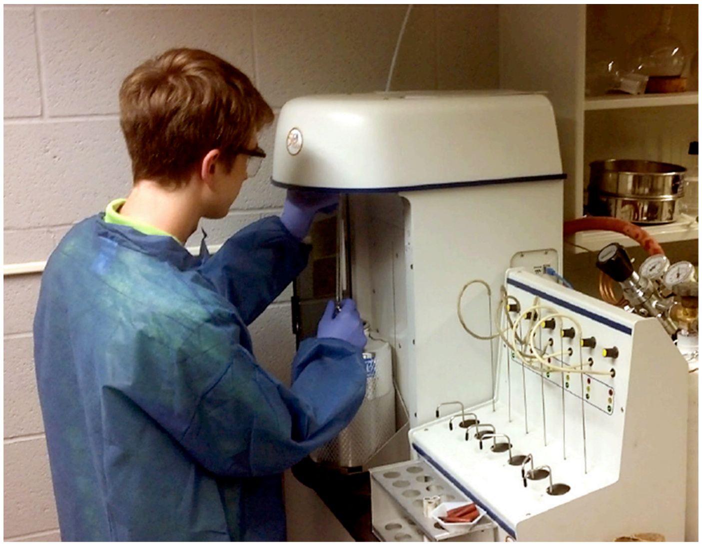
Groundbreaker Award
Michael Wright, Dr. Robert Tjoelker,
Dr. John Prestage, Dr. Eric Burt

Early Career Award
Julia Badger, Brandon Marsell, Rubik Sheth

Summer Students

Projects within NASA's Game Changing Development Program supported so many students this summer that we couldn't include them all in our last issue. Here are additional students who received hands-on experience working on future space technologies.

Leo Neat, a freshman at University of California, Santa Cruz, wrote Python software for both the High Contrast Imaging Testbed (HCIT) and the WFIRST Coronagraph Instrument (CGI). For the HCIT, he was provided data transport scripts and improved the automation of data collection and processing.
For the CGI instrument, Leo helped with processing algorithms for the removal of cosmic rays from the images.



Chemical engineering intern Mitch Eaton set up experiments for NASA subcontractor pH Matter, LLC for the NGLS SpaceCraft Oxygen Recovery Element (SCOR).

From left to right, Justin Winans, a graduate student at New Mexico State University; Amy Fritz of Prairie View A&M; and Jazmine Martinez of New Mexico State University, work on the rover technologies project.

Summer Students

Christopher Wynard, a senior at the University of Illinois in Urbana-Champaign, supported the Space Suit Assembly Development Engineering team through the Pathways internship program at NASA Johnson, where he worked on several projects including the High Performance EVA Glove (HPEG) project.

For the HPEG project, Christopher completed abrasion testing of layups of the new David Clark Phase VIId Thermal Micrometeoroid Garment (TMG). The goal of this project is to test the consistency of the testing methodology used to abrade materials and test the effects abrasion has on the degradation of glove layup samples. This work will be helpful in understanding the durability of current TMG designs for new space suit gloves.

"The opportunity to work on this project was a great experience," said Wynard. "I believe the work I am doing, along with the work of many others, will help us create an EVA Glove that will allow us to complete tasks on other planetary bodies while keeping our astronauts safe and reduce the probability of crew member injury."

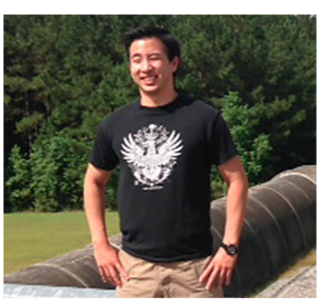
Roshonda Shurley, an intern with the EVA Portable Life Support System (PLSS) team worked with Cinda Chullen, lead for the Rapid Cycle Amine (RCA) element this summer. Roshonda reconfigured the Utility Vacuum Chamber (pictured), which supports the PLSS ventilation test loop consisting of the RCA.

AJ Eldorado Riggs, a graduate student at Princeton, worked at JPL under a NASA Space Technology Research Fellowship. His thesis work at JPL involved improving the efficiency and quality of high-contrast electric-field estimation schemes by incorporating an extended Kalman filter, and testing these algorithms using coronagraphs on the High Contrast Imaging Test bed.

Bradley Emi (Stanford), part of the JPL/Caltech Summer Undergraduate Research Fellowship (SURF) 10-week program, worked with open source community image simulation software (GalSim) for WFIRST. GalSIm currently uses optical Hubble Space Telescope (HST) imaging as its basis set for simulations. Bradley prepared near infrared HST images for ingestion into GalSim to better simulate near infrared WFIRST data.

Anne Marinan, an MIT graduate student, worked on multiple CubeSat projects. One of the CubeSats will attempt to demonstrate the use of a Deformable Mirror (DM). Anne characterized the DM while at JPL using the Zygo interferometer. She also helped with the characterization of the DM type that would be used by the WFIRST Coronagraph Instrument.

Michael Randolf (Caltech), worked on a precision radial velocity (RV) instrument with the goal of achieving 10 centimeters/second–the RV precision needed for detecting Earth-like planets. He worked on both software and hardware spectral calibration of the Echelle spectrograph orders and the instrument handling hardware.



Halston Lim (Caltech), part of the JPL/Caltech Summer Undergraduate Research Fellowship (SURF) 10-week program, worked with open source community image simulation software (GalSim) for WFIRST.He added the functionality of creating sets of dithered images to better simulate the WFIRST High Latitude Survey observational strategy.

Jacob Pate, a graduate student studying solid-state physics at University of California, Merced, returned to JPL for his fourth summer. He worked on WFIRST-AFTA test beds and technology. From measuring the blackest of paints for an upcoming Starshade test bed to aligning optics, Jake received a lot of hands-on experience in the lab.

Employees of the month
July: Daniel Yoo
August: Alan Sutton

"Within our Game Changing team, members contribute to the STMD mission of 'building, flying, testing' in everything they do. Each month we are recognizing a GCD Employee of the Month, one who embodies the strong STMD 'can do' attitude." —Steve Gaddis, GCD program manager

Daniel Yoo

Daniel Yoo has been with the GCD Program Office a little over two years and provides program integration support. He manages project data necessary to create products such as the Smart Book and the new GCD visualization mobile tools (GCD Mobile and GCD Analytics) that display the program's portfolio in a tablet application.

"Daniel is supporting the office not only by providing integration support and database management, but also tech port support, and technical assessments," says Program Manager Steve Gaddis. "He just completed a database update for our new GCD Analytics app. This is some great work!"

Daniel says he loves how well the program office is structured and organized.

"I especially like how our program emphasizes career growth and development and provides funds for us to take training to grow professionally," he explains. "The flexibility with work-life balance is also a big plus."

When enjoying the "life" side of that balance, Daniel plays tennis and goes road biking, but his biggest hobby is fishing.

"Whenever I get a chance, I go to Colonial Parkway in Yorktown with a group of friends to fish for puppy drums and Norfolk's Ocean View to fish for ribbonfish," says Daniel.

Daniel also is a big supporter of raising the next generation of children and youth as leaders, actively supporting his home church by teaching elementary students and volunteering for youth events.

Although born here in the states, Daniel embraces his Korean culture, the best of which he says is the food. "I enjoy hosting Korean barbecues at my house with friends on weekends and will gladly show anyone who is interested an experience of a lifetime!" [Yum!]

When asked about his family, Daniel is quick to share that his parents are his biggest inspiration in life. "My dad came from Korea to America when he was 18 with no money or education and worked multiple jobs for multiple years. He saved enough money from his minimum wage income to open his own business and then later helped my mom to open her own business. They currently work together as owners of a Shell gas station in Newport News."

Daniel and his one older brother both work for Booz Allen and help their parents out at the store on weekends by shopping for inventory and restocking. Mom and Dad might have to plan some extra help soon, however, because Daniel plans to move out of his parents' home next July as he and his lovely fiancé have set their wedding date.

Alan Sutton

Alan Sutton has been GCD's systems administrator for a year now, maintaining the organizational computers, keeping and updating the current events TV and space weather TV, managing permissions for GCD's Sharepoint, and serving as backup to the front office as a point of contact and ViTS coordinator.

"Among his many and varied areas of support, recently Alan completed a display involving Space Weather," Steve says. "It involved running many yards of computer cabling as well as technical and interactive issues to be resolved so that the display operates in real time. The result is impressive and I really appreciate him taking on the challenge."

A man of generally quiet demeanor and exercising a good bit of brevity in answering interview questions, Alan's response to why he enjoys supporting GCD included two clear reasons. He says, "I'm constantly learning new things, and this is a great group of people to work with."

Alan and his wife, Victoria, have two children: Aiden who is three, and Mekayla, now seven months old. If you have the opportunity to ask him, Alan's got pictures and videos of them on his Smartphone, including Mekayla learning to crawl. [Love!]

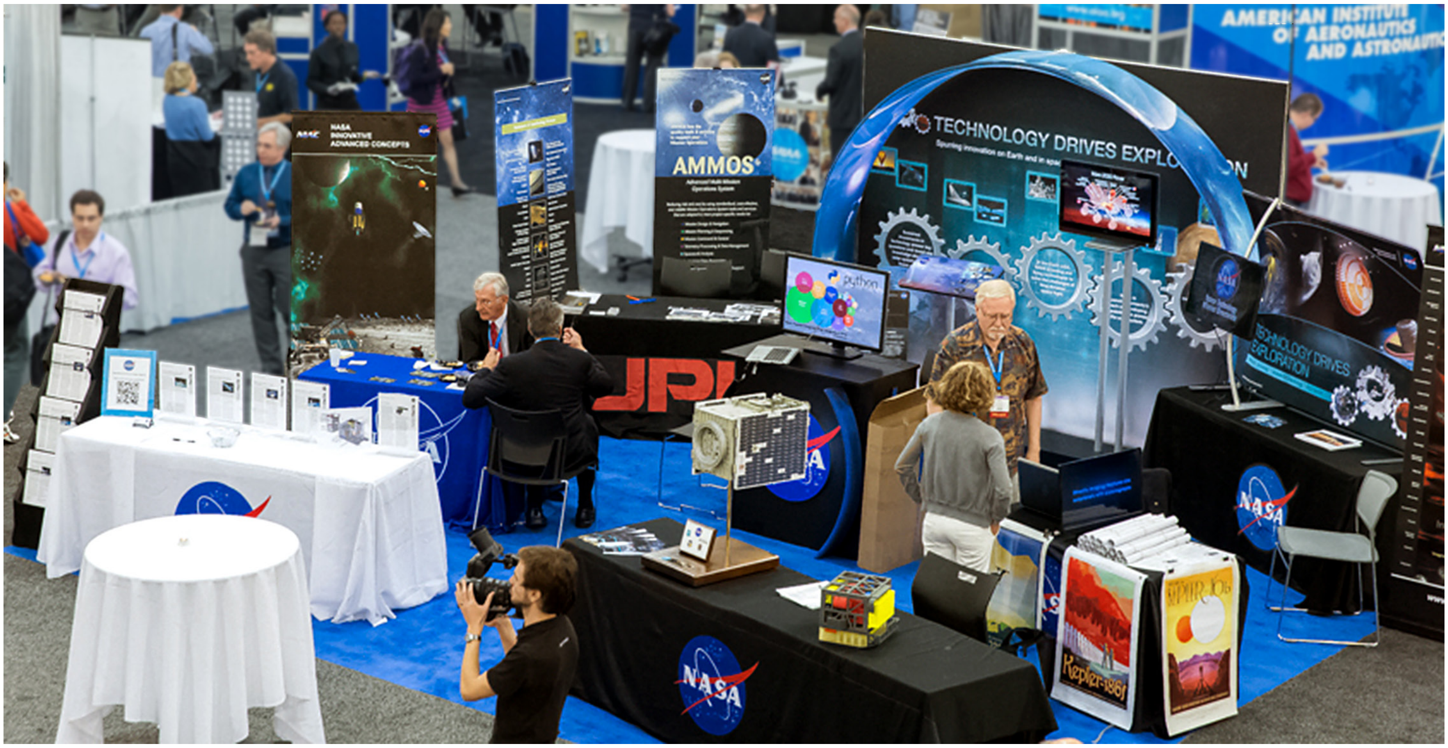
One of his favorite things to do is read, but Alan's time outside the office is primarily dedicated to the art of play, with his children, of course. Mekayla has a little bit to go just yet, but surely Aiden will be right there with Dad helping along when she's old enough for all those coloring, matching games, and building blocks activities.

Education & Public Outreach

A Comic-Con attendee poses with R2.

NASA Makes First Appearance at Comic-Con

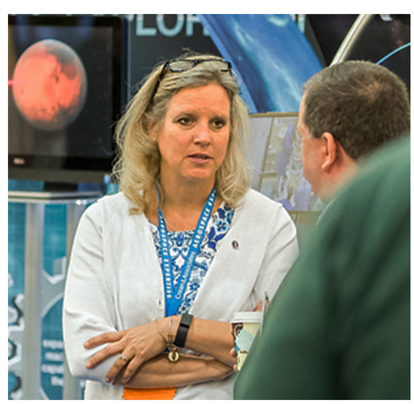
Even though it was a small space, NASA made a big impact on the tens of thousands of attendees at this year's Comic-Con International event in San Diego, Calif. The highly visible and eccentric event draws a diverse crowd from the tech savvy to families to the likes of MythBuster's Adam Savage. In addition to several NASA panels that included talks about the agency's Journey to Mars and science fiction versus science fact, guests could stop by the NASA booth in the exhibit hall where they could look at real Mars images through Oculus Rift, check out a model of NASA's Space Launch System or take a "selfie" with Robonaut 2.



Make Space for NASA in Pasadena

NASA's Space Technology Mission Directorate supported the 2015 AIAA Space and Astronautics Forum in Pasadena, Calif., August 31-September 2. Several STMD projects were involved in plenary and panel sessions as well as paper presentations. STMD AA Steve Jurzyck was a highlighted speaker at the event. In the exhibit hall, GCD supported with hardware from its HIAD2 and Coronagraph projects.

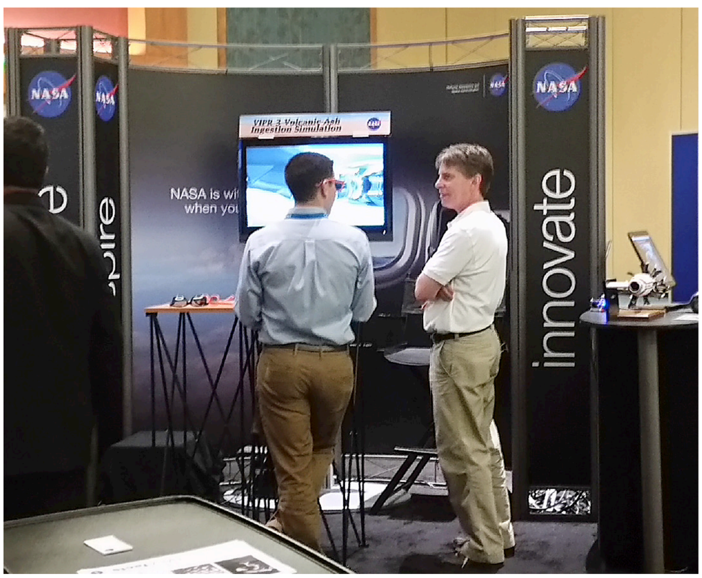
Project Manager Feng Zhao speaks with a group of students about the work he is doing on Coronagraph as part of the WFIRST mission. AIAA forum and conference image credits: AIAA.

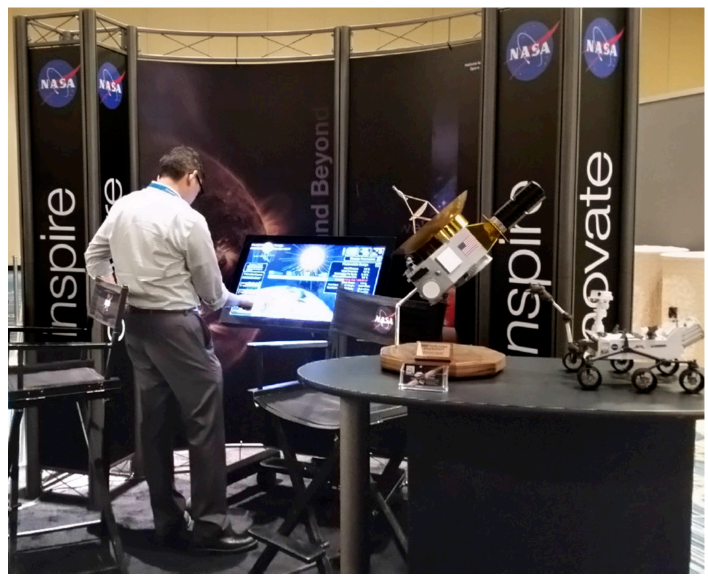


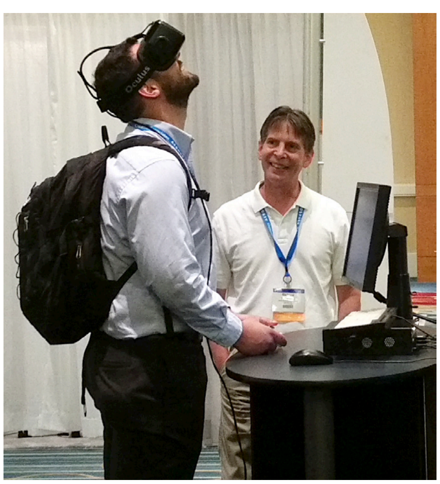
GCD Integration Manager Mary Beth Wusk speaks with visitors at the booth.

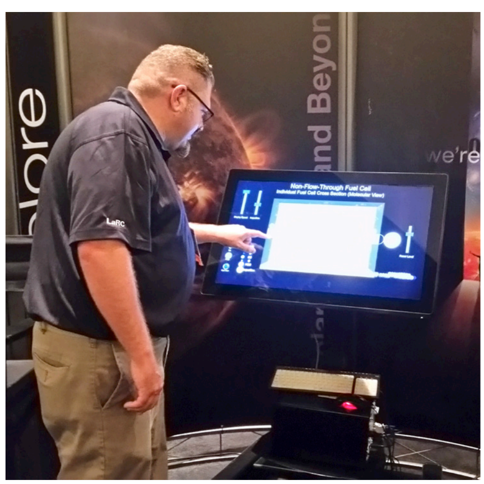
A Powerful Presence at AIAA

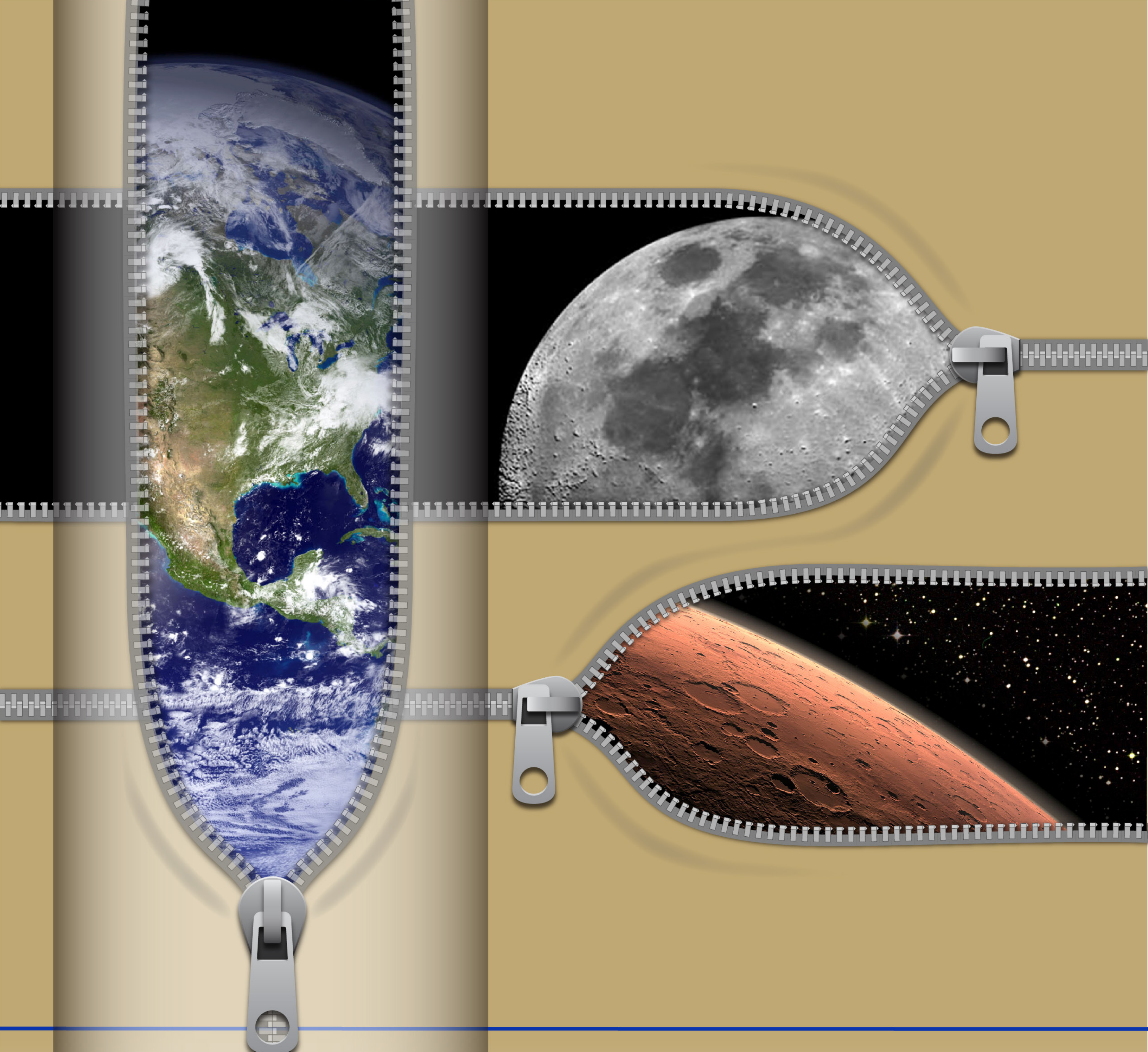
NASA's Game Changing Development Program supported the annual AIAA Propulsion and Energy Conference in Orlando, Fla., this year with several exhibits. Two animated interactive displays showcased our work in photovoltaics and advanced energy storage, and models of our work in nuclear systems and micro-electrospray propulsion were also in the exhibit. NASA's Space Launch System, Technology Demonstration Missions Program, Aeronautics Mission Directorate and NASA's Stennis Space Center also supported.











Game On!

http://gameon.nasa.gov

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