Lunar Surface Innovation
CONSORTIUM

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LSIC Newsletter

The Lunar Surface Innovation Consortium is administered by the Johns Hopkins Applied Physics Laboratory and operates in collaboration with the NASA Space Technology Mission Directorate under the Lunar Surface Innovation Initiative. Its purpose is to harness the creativity, energy and resources of the nation to help NASA keep the United States at the forefront of lunar exploration. To find out more, sign up to participate or access past additions of this newsletter, please visit lsic.jhuapl.edu.

Director's Corner

Hello LSIC Community!

Let's start with the successful 2023 LSIC Fall Meeting hosted by the Community College of Allegheny County (CCAC) in Pittsburgh, Pennsylvania, with tours and extras hosted by Moonshot Museum, Astrobotic, Keystone Space Collaborative, and Carnegie Mellon University. There were announcements from NASA Space Technology Mission Directorate covering the upcoming RFI for a technology-forward In Situ Resource Utilization (ISRU) demonstration, Lunar Infrastructure Foundational Technologies-1 (LIFT-1). And DARPA announced not only the awardees for LunA-10 and its new interoperability effort, but also the Lunar Operating Guidelines for Infrastructure Consortium (LOGIC). The event featured roughly 250 in-person attendees, close to 300 virtual attendees, and around 75 submitted abstracts! Although feedback is still being compiled, our team members plan to incorporate what we learn into future efforts. We'd also like to congratulate the winners of the Caterpillar simulated "lunar" remote and telerobotic operator race!

Our third hybrid workshop, Transition to Commercial Lunar Operations Workshop, took place in October. Held in collaboration with several NASA stakeholders, industry stakeholders, and Clive Neal (University of Notre Dame), this event offered an opportunity for commercial partners to discuss key issues regarding their participation in developing and operating infrastructure in the cislunar ecosystem. Open-agenda networking events like this one appear to be a big hit with our community. At our November 7 **Path to Sustainable Technologies in the Lunar Surface Environment Workshop**, we discussed what technologies are available and what gaps exist related to the combined lunar and dust environment.

With all these important things going on, our LSIC team will be steering through updates needed to keep our community in the know. We have moved to a bi-monthly cadence for our newsletter but still intend to fill everyone in on all the amazing things going on in lunar! Last but not least, we are on the hunt for our 2024 Fall Meeting location (additional details to come).

As always, "Teamwork makes the dream work!" Let's keep pushing … to the Moon!

Jamie Porter
Director, Lunar Surface Innovation Consortium
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Focus Areas

Monthly Telecon Schedule

Dust Mitigation
Third Thursdays at 12 PM Eastern

Excavation & Construction
Next: Wed., Dec. 6 at 2 PM Eastern

Extreme Access
Second Thursdays at 3 PM Eastern

Extreme Environments
Second Tuesdays at 3 PM Eastern

In Situ Resource Utilization
Third Wednesdays at 11 AM Eastern

Interoperability
First Wednesdays at 1 PM Eastern

Lunar Simulants
Second Thursdays at 1 PM Eastern

Lunar Surface Innovation CONSORTIUM

Surface Power
Next: Thur., Dec. 7 at 11 AM Eastern

LSIC General Updates

Path to Sustainable Technologies in the Lunar Surface Environment Workshop, Nov. 7

The Dust Mitigation and Extreme Environments Focus Groups hosted the Path to Sustainable Technologies in the Lunar Surface Environment Workshop on November 7. This event comprised three sessions: (1) Existing Standards and Facilities, (2) Stakeholder Needs Panels, and (3) Town Hall on Next Steps. The sessions and talks were recorded and will be posted on the workshop agenda in the near future.

Focus and Working Group Updates

Dust Mitigation

The Dust Mitigation (DM) Focus Group held its monthly meetings on September 21 and October 19. The September meeting included a panel discussion on lunar dust testing with simulants. Our featured speakers were Andrea Cammarano and Hossein Zare-Behtash (University of Glasgow), Addie Dove (University of Central Florida), Melissa Roth (Off Planet Research), Katy Hurlbert (NASA-JSC), and Nathan Jimenez (NASA-GRC). The October meeting focused on plume surface interaction (PSI) and included a presentation by Cecily Sunday (University of Maryland) on PSI modeling and her results. This was followed by an overview of the Lunar ExoCam presented by Jason Achilles. We thank our speakers for sharing their experiences and results. Both meetings generated valuable discussion and contained information on upcoming opportunities for technology development. Recordings and slides from both meetings are available on the LSIC Dust Mitigation focus area page.

In lieu of their November Focus Group meetings, the Dust Mitigation and Extreme Environments focus areas held the virtual Path to Sustainable Technologies in the Lunar Surface Environment Workshop on Tuesday, November 7. The objective for this workshop was to focus on the qualification path for fielding long-lived technologies on the lunar surface. Stakeholders across industry, academia, and NASA discussed the current state of the art as well as essential knowledge and technology gaps related to the lunar environment.

Excavation and Construction

In October, the Excavation and Construction (E&C) Focus Group engaged the LSIC community via the 2023 LSIC Fall Meeting and AIAA ASCEND conference. An E&C monthly focus group meeting was not held.

The next E&C monthly meeting will be held Wednesday, December 6 at 2 p.m. EST; note that the November and December meetings are being combined and held on a day outside our usual cadence. We are looking for small businesses and student groups to present 5- to 10-minute lightning talks. Contact Sarah Hasnain or Jibu Abraham if you are interested in presenting.

You can keep the conversation going on Confluence via our four subgroups: Autonomy, Maintenance, Site Planning & Prep; Additive Manufacturing, Raw Materials; Horizontal & Vertical Construction; and Outfitting & Maintenance.

Extreme Access

These past few months have been packed with planning and running the LSIC 2023 Fall Meeting! While all this work was happening, the Extreme Access (EA) Focus Group still managed to host some meaningful technical talks with the community. The month of September saw two presentations from our subgroups. The Communications subgroup held a presentation by William Menniger, Dave Rosener, and Dan White (Stellant Systems) on "RF Components for Lunar Communications Systems." Additionally, the Autonomy subgroup hosted David Handelman (JHU/APL), who spoke on integrating artificial intelligence, augmented reality, and robotics for human-autonomy teaming.

In October, the focus group facilitated two more technical chats, one from our Position, Navigation, and Timing (PNT) subgroup and one from our Autonomy subgroup. Our PNT subgroup saw a presentation from Brodie Wallace (University of Colorado Boulder) on "A Lunar Surface Pseudolite Architecture for Regional Communication and Radionavigation." And finally, our Autonomy subgroup brought in Dr. Nhut Ho and his team (ARCS) to present on the STEAHM Bubble project.

We hope that everyone who attended the LSIC 2023 Fall Meeting had a wonderful time in Pittsburgh, and we look forward to hearing your feedback on the experience in upcoming gatherings!

Extreme Environments

Extreme Environments (EE) had a busy fall season, with several fascinating talks at the EE monthly and subgroup meetings. The discussions between the Regolith/Surface Interface and Vacuum/Exosphere Environment subgroups, where key topics of vacuum interactions with regolith and simulant were addressed, were of particular interest to our community. To access any of these recordings and presenter materials, please visit the EE Confluence page.

October was fully committed to our LSIC Fall Meeting, which was an incredible conference with impressive in-person and virtual attendance! We were pleased to see so many EE-relevant presentations. It is a great reminder that our community's work is at the forefront of technology development for the Moon. Our EE Focus Group is one of many contributors to the awareness of the significant environmental challenges on the Moon, and we will continue to highlight and discuss these as we move forward with our work in the winter season.

In lieu of their November Focus Group meetings, the Dust Mitigation and Extreme Environments focus areas held the virtual Path to Sustainable Technologies in the Lunar Surface Environment Workshop on Tuesday, November 7. The objective for this workshop was to focus on the qualification path for fielding long-lived technologies on the lunar surface. Stakeholders across industry, academia, and NASA discussed the current state of the art as well as essential knowledge and technology gaps related to the lunar environment.

Please feel free to contact our facilitator, Milena Graziano, with any questions or comments.

In Situ Resource Utilization

In September, the In Situ Resource Utilization (ISRU) Focus Group monthly meeting was pushed back a week (to September 27) to avoid conflicting with the Lunar Exploration Assessment Group (LEAG), at which several ISRU Focus Group facilitators presented. At the September ISRU monthly meeting, we had two talks: Danielle Mortensen (JHU/APL, Extreme Access FG) presented an overview of the NASA TechPort website and demonstrated how beneficial this tool can be, and Andy Krebs (Argo Space) discussed Argo Space's technology to develop propellant from water. We concluded with a coffee and donuts discussion in small breakout groups to talk about our expectations for the LSIC Fall Meeting.

The entire ISRU Focus Group supported the LSIC Fall Meeting held October 10–11, as well as the Transition to Commercial Lunar Operations Workshop on October 12. We had an incredible time! It was wonderful catching up with all of you and hearing about all the great things our community is working on through the many talks, panels, and posters that were presented.

The ISRU Focus Group canceled its October monthly meeting to reduce meeting fatigue, as it fell during the week between the LSIC Fall Meeting and the ASCEND conference. The ISRU facilitators had a strong showing at ASCEND as well and were excited for the opportunity to share and present what we've been working on, as well as network further with our community.

At our November monthly meeting, we're looking forward to a talk by Kathryn Hadler (ESRIC), who will be providing an overview and update on activities of the European Space Resources Innovation Centre (ESRIC). As a reminder, all ISRU monthly meetings going forward will occur the third Wednesday of the month at 11 a.m. EST!

Surface Power

In September, the Surface Power (SP) Focus Group and the Interoperability Working Group jointly hosted Jeff Csank (NASA GRC), Tom Bozada (U.S. Army Engineer Research and Development Center, ERDC), and Dan Herring (MIT) for a discussion of the DoD/U.S. Army Tactical Microgrid Standard. The standard itself is a set of communication and control protocols that allow microgrid components to seamlessly interface with one another, promoting interoperability and the optimal distribution of power from a variety of sources. Jeff Csank kicked off the meeting with a discussion of NASA's current collaboration with the Army ERDC and MIT teams. NASA is currently in the midst of a study to assess the usability of the standard in the lunar environment. Next, Tom Bozada provided some valuable historical perspectives on the standard's genesis, development, various demonstrations, improvements, and current status. Similar to other industry standards, the microgrid standard was developed collaboratively through a consortium that brought together stakeholders from the government, industry, and academia. Finally, Dan Herring discussed the more technical aspects of the standard itself. This included an overview of the overall system architecture, how the network discovers new elements, the logic involved in determining which controller has priority control of which elements, and failure modes.

The October SP telecon featured presentations from Dr. Eric Maxeiner and Dr. Jonathan Adams (Rolls Royce). The speakers provided an overview of Rolls Royce's various space nuclear initiatives, both in the United Kingdom and in the United States. The talk sparked an interesting discussion of the feasibility of collaborations between different companies independently pursuing designs for a lunar fission surface power station.

The SP Focus Group's next monthly telecon will take place on Thursday, December 7, at 11 a.m. EST and will review the last years' worth of activities within the consortium. This will serve as both the November and December telecon as the regularly scheduled dates of November 23 and December 28 coincide with winter holidays. The first telecon of 2024 will be hosted jointly with the ISRU Focus Group. The event will occur on January 17 and will focus on the topic of landing site selection at the lunar South Pole. If you are interested in presenting at a future LSIC Surface Power telecon, please contact Matt Clement and Sam Andrade.

Interoperability Working Group

The Interoperability Working Group would like to bring to your attention the exciting news announced at the LSIC fall meeting—the establishment of the Lunar Operating Guidelines for Infrastructure Consortium (LOGIC)! Through LOGIC, DARPA aims to convene stakeholders across industry, academia, and government to identify critical lunar infrastructure interoperability and interface needs. It will work closely with LSIC and with NASA's Lunar Surface Innovation Initiative (LSII), seeking to accelerate the development of consensus-driven interoperability standards in areas such as power distribution, communications, positioning, navigation and timing, lunar surface surveying, and cislunar space traffic control. We hope you will visit the LOGIC website and register to stay informed.

Lunar Simulants Working Group

The Lunar Simulants (LS) Working Group hosted the LSII Simulants Team for the September Speaker Series, and they shared with us a fantastic overview of all the lab analyses completed for the Lunar Simulants Assessment since they started in 2020. If you missed it, you can still catch the playback of past speakers on Confluence. We are arranging speakers for the near future, so don't forget that for those months that we meet, the speaker series will be held on the second Thursday of the month at 1:00 p.m. EST! If you are interested in being informed about future talks in our Speaker Series, please email our LSWG team so that you can be added to our list. We are also interested in hearing about your simulant-related research and are accepting topic suggestions that you'd like to hear more about. If you would like to volunteer to be a speaker or have an idea for a topic that you'd like covered or a speaker you'd like to hear, please email us!

Feature Article

Autonomy Workshop

By: Danielle Mortensen

On August 21 and 22, the EA and E&C Focus Groups teamed up to host the very first Autonomy Workshop, fully online. Over 233 unique participants attended over the course of both days, including representatives from academia, government, industry, and non-profits as well as a wide array of international partners. The EA and E&C teams would like to thank all those who participated in the workshop and commend those involved in producing extremely diverse, creative, and innovative ideas, gaps, and solutions relating to space autonomy, as it exists today. The full recording is available. Results, abstracts, biographies, and more can be found on Confluence.

The workshop objective was "to gather the lunar community to exchange ideas on autonomy, as well as identify technology gaps and use cases for establishing a sustainable presence on the Moon and Mars." Our primary goal was to answer the question: "How can NASA's Space Technology Mission Directorate (STMD) help academia, commercial/industry, non-profit, etc., to develop autonomous technologies which can be used for sustained presence on the Moon and exploration of Mars?"

The workshop was divided into four sessions:

1) Autonomous Systems, Situational and Self Awareness, Reasoning and Acting
2) Collaborative Systems
3) Lunar Applications in Autonomy
4) Challenges in Autonomy

Each session consisted of a 40-minute panel, three 10-minute presentations, and a networking discussion in which participants joined breakout groups where, using Miro (a digital collaboration platform), they discussed their experiences and thoughts on the session. Following the introduction to the format of the workshop, Kevin Somervill (NASA) began Day 1 with a presentation briefly describing LSII and LSIC, the NASA Moon to Mars goals and objectives, upcoming STMD demonstration ideas, and goals for the workshop.

There were six main takeaways from this workshop, described below. These findings were presented at the LSIC Fall Meeting in Pittsburgh, Pennsylvania, on October 10 and 11.

Autonomous systems will be necessary to enable a sustained lunar presence. The specifics of these systems, and the level of autonomy needed, will be scenario dependent.

The participants of this workshop made it clear that autonomous systems are essential to the success of future lunar missions, especially with regard to human presence on the Moon. Some form of autonomy will be either required or an invaluable asset to nearly all aspects of lunar exploration. The specifics of the level of autonomy (supervised, partially supervised, unsupervised), the actions and/or systems that will need to operate autonomously, and the interaction between autonomous systems and astronauts on the surface need further definition as specific missions and scenarios are outlined going forward.

There is a current lack of infrastructure components (e.g., communications network, power capabilities, PNT services) that are key to supporting autonomous systems on the Moon.

Autonomous systems rely on certain infrastructures and will rely on those infrastructures being well-established on the Moon. Power networks and robust computing hardware are especially needed to support the high level of computation required by most autonomous systems. Communications networks along with position, navigation, and timing services (PNT) will aid a lunar system to act autonomously. The availability of a network, and the bandwidth that is available, will be important to consider when putting autonomous systems on the surface of the Moon.

Autonomous systems need to be accounted for during mission design, not built in afterward.

We need to build autonomous systems, not systems that do autonomy. Autonomous systems have several specific requirements for attributes, such as substantial power systems, significant computational power, specific software, etc. These systems will be successful if they are designed, built, and tested as a primary component of the mission. It is much more difficult to shoehorn autonomous systems (and all they entail) into an already built/designed infrastructure and architecture—and more expensive—than to design and plan for it from the beginning.

Data needs for computer vision algorithms and training of machine learning networks are high and not supported by current space-grade technology.

Current space-grade technology does not compare to terrestrial capabilities. Size, weight, and power (SWaP) are all limited commodities in space but essential to a high-performing autonomous system. Technology developments in this field should focus either on increasing SWaP capabilities or on decreasing computational requirements for autonomous systems.

There is a need to lower barriers to entry for new players in autonomous space systems, which may include greater funding opportunities, digital engineering tools, and specific use cases and requirements to define autonomy needs at appropriate levels.

Small businesses, start-ups, and international entities routinely request increased support and opportunities for developing robust and successful space systems. During the Autonomy Workshop, this was echoed by for groups that are developing autonomous technologies. Limited access to funds, testing tools/simulations/proving grounds, and previous data is a barrier to entry for these new players who could diversify and innovate on current technologies. In addition, the community called for specific use cases and requirements that define the needs for autonomous systems. These companies are hesitant to develop technologies and test them when they are unsure of whether their product will be useful to, and bought by, larger stakeholders such as NASA. Defining use cases for autonomous systems will help these companies to confidently develop their technologies with the knowledge that there is a specific need and desire for them.

An open-source "sandbox" for autonomous system development, as well as data and model sharing, is needed to support interoperability and continued progression in autonomy technology innovation.

The creation of an open-source database, or perhaps even a physical testing location, for sharing information relevant to the development of autonomous technologies would be instrumental in the rapid innovation needed to attain autonomy levels that can support upcoming lunar exploration and presence. There is high value in sharing data, models, simulations, and, particularly, failed experiments in the interest of continuously moving forward in our innovations. There are many "repeated efforts" occurring in the development of autonomous space systems simply because there is no common space for sharing information or an open sharing of what is being developed and its progress.

In all, LSIC's first Autonomy Workshop was a large success and provided a plethora of valuable information to the community, JHU/APL, and NASA. These lessons will be passed on, and a series of follow-ons to the Autonomy Workshop are being planned into LSIC's future. These follow-ons will delve into the challenges and problem spaces outlined in this first gathering. Autonomy must be seen as a high priority in support of presence on the Moon and as a proving ground for future missions to Mars. LSIC will continue to address and explore the issues of uncertainty and technology gaps that surround the topic of autonomous systems as they become more and more instrumental in attaining our goals of sustained presence on the Moon.

Questions about the Autonomy Workshop or our findings can be sent to Danielle Mortensen.

Member Spotlight: Caterpillar, Inc.

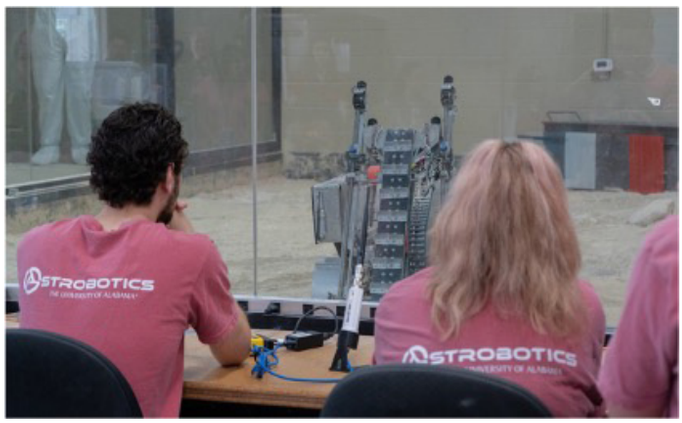
By: Michael Buckley

Call it a challenge within the challenge. Set apart from the main area of the Robotic Mining Challenge at the University of Alabama (UA) last May was a station where the student competitors could leave their own robots aside and attempt to remotely race a small machine through a simulated lunar base—hundreds of miles away at a **Caterpillar Inc.** location in North Carolina.

"For the CAT Command challenge, we set up a pallet with a tire that represented a water receptacle, and the students—operating a vehicle from Alabama using a CAT Command Remote Operating Station—had to pick it up, drive it to another location that represented a habitat, prop it on the ground, then return and park the machine," explained Eric Reiners, automation and autonomy program manager for Caterpillar's Integrated Components and Solutions Division. "They were timed on this throughout the week, and it became a competition on who was the best simulated lunar-vehicle operator."

Watching the college students enthusiastically embrace an extracurricular competition reiterated to Reiners just how seriously the next generation of engineers and scientists take opportunities to join humankind's return to the Moon. That's something the global engineering equipment manufacturing firm has long recognized, a reason behind its sponsorship of national competitions such as NASA's Lunabotics, and a driver behind Caterpillar teaming up with UA to set up the in-person Robotic Mining Challenge for last spring.

"It was important to provide a venue for students to physically run their robots, and to have the experience of running them against other teams," Reiners said. "You find that when you bring them all together, they start to interact and share ideas and solutions with each other. That whole experience, I think, is important in the overall aspect of the competition."



The University of Alabama team readies its robot for the Robotic Mining Challenge. (Credit: University of Alabama)

The event drew 22 teams from around the country to the UA campus in Tuscaloosa from May 22 to 26. Each team had spent the academic year designing and building a robot to excavate buried "ice" on a simulated lunar surface. For the competition, watching on screens from another room, operators remotely piloted their robots around rocks and craters before reaching the "ice"—a layer of rock buried about 12 inches below the surface. The robots had to dig through the dust, or regolith, collect the rock and negotiate more obstacles before delivering their load to a collection bin—with the teams earning points on factors like the amount of rock they collected or the levels of autonomy programmed into the robot.

"Some teams were actually able to give their robot a 'go' signal, without sending another command," Reiners said. "That level of autonomous decision-making was very impressive and exciting to watch."

Beyond observing, Reiners said his team also gains quite a bit from speaking with the students.

"We talk with the teams, and try to understand their approaches and their processes," he said. "Part of our goal is to understand where the top student talent is in this community. And that we are able to participate in competitions like this, which drive students to develop and demonstrate their skills in key technologies like autonomy, is very positive for us in terms of potential talent attraction."

The Michigan Tech team watches its robot Automated Regolith Excavation System (ARES) complete a practice run at the Robotic Mining Challenge. (Credit: Michigan Technological University)

Aside from recruiting opportunities, competitions such as the Robotic Mining Challenge and Lunabotics offer NASA and its prospective industry and academic exploration partners valuable insight into the design of robots and innovative construction techniques for lunar and Martian environments. And they take the competition seriously. NASA says it assesses Lunabotics student designs and data against the same standards it sets for the agency's own prototypes, and Reiners says Caterpillar sees these student events as an opportunity to look at customer challenges—and potential solutions—through a different lens.

"These competitions offer chances for the students to solve problems," he said. "That's a great learning opportunity for all the students, but it's also an opportunity for NASA and industry to see those different types of solutions, and which ones may work better than others, contributing to the longer-term development of technology that may ultimately be used both on the lunar surface and here on Earth."

How did teams fare at the Robotic Mining Challenge? Read UA's wrap-up of the competition. You can catch a preview of the challenge on the UA YouTube channel.

NASA and Community News

Community News

Over the Moon: Defense Agency Picks 14 Companies to Build Space Economy

10/11/2023 \\ Pittsburgh Post-Gazette \\ Evan Robinson-Johnson
https://www.post-gazette.com/business/tech-news/2023/10/11/darpa-funding-moon-economy-lunar-surface-innovation-consortium-pittsburgh/stories/202310110103

Johns Hopkins APL Teaming with DARPA to Accelerate Interoperability Standards for Commercial Lunar Infrastructure

10/11/2023 \\ JHU/APL \\ Michael Buckley
https://www.jhuapl.edu/news/news-releases/231011b-lunar-technology-development

Accelerating Interoperability Standards for Commercial Lunar Infrastructure

10/11/2023 \\ DARPA \\ Outreach@darpa.mil
https://www.darpa.mil/news-events/2023-10-11

'Be Successful': The Lunar Surface Innovation Consortium Meeting Comes to Pittsburgh

10/16/2023 \\ Pittsburgh Post-Gazette \\ Evan Robinson-Johnson
https://www.post-gazette.com/business/tech-news/2023/10/16/space-conference-pittsburgh-nasa-lunar-surface-innovation-consortium-darpa/stories/202310110138

The Challenge to Design Sample Collection for a Lunar Rover

10/17/2023 \\ AuManufacturing
https://www.aumanufacturing.com.au/the-challenge-to-design-sample-collection-for-a-lunar-rover

DARPA's LOGIC Initiative: Shaping the Pathway for Lunar Infrastructure Development and Off-World Societies

10/18/2023 \\ The Debrief \\ Tim McMillan
https://thedebrief.org/darpas-logic-initiative-shaping-the-pathway-for-lunar-infrastructure-development-and-off-world-societies/

Employment Opportunities

https://lsic.jhuapl.edu/Resources/Opportunities.php?f=Job

Funding Opportunities

Tech Development Opportunities

- **"NASA Seeks Input for Future Lunar Surface Resource Utilization Demo"**
  November 6, 2023 \\ NASA \\ Stefanie Payne
  Request for Information deadline: December 18, 2023, at 5 p.m. ET
  NASA will host an industry forum on Monday, November 13, 2023, at 1 p.m. ET
- **"Lunar Infrastructure Foundational Technologies-1 Demonstration"**
  Request for Information deadline: December 18, 2023, at 5 p.m. ET
  NASA will host an industry forum on Monday, November 13, 2023, at 1 p.m. ET
- **"Fission Surface Power Advanced Closed Brayton Convertor (FSP-ACBC) system" as an Appendix to the "Space Technology Research, Development, Demonstration, and Infusion"**
  Inactive date: July 1, 2024
- **"NASA Seeks Development of Universal Payload Interface"**
  Registration deadline: February 1, 2024, at 5 p.m. ET
  Application deadline: February 22, 2024, at 5 p.m. ET

Student Tech Opportunities/Competitions

- **NASA's 2024 BIG Idea Challenge: Inflatable Systems for Lunar Operations (Theme Preview)**
  The Breakthrough, Innovative & Game-changing (BIG) Idea Challenge is a collegiate-level design competition sponsored by NASA and managed in a partnership with the National Institute of Aerospace (NIA) and JHU/APL. To participate, teams of approximately 5 to 25 students will submit proposals on concepts for a wide range of solutions for inflatable technologies, structures, and systems for lunar operations. Selected teams will receive up to $180,000 to build and test their proposed inflatable solutions and then present their test results to a panel of NASA and industry experts at the BIG Idea Forum in November 2024.
  Proposal deadline: January 23, 2024

Future Solicitations and Opportunities

- **NASA Innovative Advanced Concepts (NIAC) 2024 Phase I Call for Proposals**
  The NIAC program supports visionary research ideas through multiple progressive phases of study. Phase I studies are nine-month efforts to explore the overall viability and advance the technology readiness level (TRL). Eligible recipients of Phase I awards can propose for a follow-on Phase II study.