



# 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](https://lsic.jhuapl.edu).

Director's Update	2
LSIC General Updates	3
Feature Article	6
Member Spotlight	8
NASA News	10
Funding Opportunities	13

# Director's Update

I am so excited to see many of you in a couple of days! Our agenda, which can be viewed on the website (<https://lsic.jhuapl.edu/dev/Events/Agenda/index.php?id=148>), features a number of exciting talks that will provide information about NASA's investments, especially with respect to autonomy and robotics, as well as some broader community-related topics such as student engagement and activities in lunar exploration, how to leverage partnerships to provide opportunities to new groups of students and small businesses, and what kinds of concerns investors have when looking at the growing space economy. We will take a systems-level look at autonomy needs in the context of the architecture for a permanent lunar base, with a panel discussing large-scale infrastructure and robotics concerns and then a series of breakouts groups.

The breakout discussions will build on NASA's Break the Ice Challenge, which assumed that, in a location around a permanently shadowed region (PSR) near the lunar South Pole, NASA would have in place three NASA assets: a NASA Power Plant, NASA Power Distribution, and a NASA Water Extraction Plant. Our big-picture question to the groups will be: What robotic or autonomy capabilities are critical to establish, operate, and maintain that infrastructure? We have designed the panels and agenda to provide background to feed into this, but for those who plan to attend that would like to read up in advance, two resources are highlighted below. Groups should consider what they have heard earlier in the day about some of the investments in robotics and mobility that NASA has made (or those they are aware of and whether there are technical gaps or environmental concerns that they think have not been addressed. Participants from different focus groups should help bring their specific areas' concerns to the table, so that the group can look for overlap or areas that might be falling through the cracks.

**Resources**

<https://science.nasa.gov/science-pink/s3fs-public/atoms/files/NASA%202018%20Autonomy%20Workshop%20Moon%20DRM%20reports.pdf>

Austin, A., Sherwood, B. et al. 2020. Robotic lunar surface operations 2. Acta Astronautica 176, pp. 424-437. <https://doi.org/10.1016/j.actaastro.2020.06.038>.



**Rachel Klima**

Director, Lunar Surface Innovation Consortium

[SES-LSIC-Director@jhuapl.edu](mailto:SES-LSIC-Director@jhuapl.edu)

## Focus Areas

Monthly Telecon Schedule

**Dust Mitigation**

Third Thursdays at 12PM Eastern

**Extreme Access**

Second Thursdays at 3PM Eastern

**In Situ Resource Utilization**

Third Wednesdays at 3PM Eastern

**Excavation & Construction**

Fourth Wednesdays at 2PM Eastern

**Extreme Environments**

Second Tuesdays at 3PM Eastern

**Surface Power**

Fourth Thursdays at 11AM Eastern

# LSIC General Updates

## CIRCUIT Intern Introduction: Shivanie Ally

Hello! My name is Shivanie Ally, and I am an intern for CIRCUIT at the Johns Hopkins University Applied Physics Laboratory (JHU APL) working on the Lunar Surface Innovation Initiative (LSII) project! I am a Junior at Johns Hopkins University, and I am currently majoring in Electrical Engineering. For the LSII project, I have been primarily working with the Surface Power focus group, but I plan on working with the Excavation and Construction focus group in the future. So far in the CIRCUIT program, my cohort and I have accomplished a few tasks. First, we did research on illumination patterns of the moon to determine a way to have constant illumination year-round. We have also begun working on a Lunar Simulator website, which is meant to simulate a lunar base, given certain inputs. I have researched data for this website and am currently helping with its planning process. We are looking forward to where we can take this project, and its potential usefulness in planning a lunar base!

I am also working with a fellow CIRCUIT intern to code a program that can aid in organization of the LSIC database, as well as generation of reports to NASA. We hope that this can speed up clerical processes, so that focus can be diverted to more salient causes.

Outside of my internship at CIRCUIT, I am a member of the Wind Energy Team at my school (Hopkins Student Wind Energy Team) working with the electronics and controls team! Our team won second place this year in the Collegiate Wind Competition (CWC) hosted by the DoE. I am currently working with the team for the CWC in 2022! I have recently joined the Rocketry team (AstroJays), working with the Avionics subteam. I am looking forward to applying skills that I have learned from these clubs into my CIRCUIT project!

## Focus Group Updates

### Dust Mitigation

The Dust Mitigation (DM) Focus Group has continued to work on revamping our Confluence page to better facilitate collaborations, discussions, and access to resources and is in the processing of kick-starting our subgroups to engage the community in different areas of interest. On October 7th, we held our very first Special Dust Mitigation Focus Group Meeting, a NASA PRISM/CLPS Networking Event. This event was a teaming session to provide the community a space for teaming among LSIC members for NASA's PRISM call and future CLPS opportunities. It was a great way for the community to meet new people and learn about different ongoing dust mitigation efforts. We hope to plan additional similar events in the future. If you are looking to team up, take a look at our Confluence page (<https://lsic-wiki.jhuapl.edu/x/oIGXAQ>). We also held our monthly meeting on October 21st, where we heard a presentation from Dr. Kristen John (NASA JSC) on the newly-released, NASA Technical Standards Document NASA-STD-1008 (<https://standards.nasa.gov/standard/nasa/nasa-std-1008>): "Classification and Requirements for Testing Systems and Hardware to be Exposed to Dust in Planetary Environments," followed by a Q&A session with the community. To add comments/feedback, visit the meeting page on Confluence (<https://lsic-wiki.jhuapl.edu/x/i4CBAQ>). Our next monthly meeting on Thursday, November 18th at 12:00 PM Eastern will focus on Plume Surface Interaction, with a presentation from Dr. Wesley Chambers from NASA Marshall Space Flight Center.

### Excavation & Construction

The E&C focus group had a workshop-style monthly meeting on October 27, the topic of discussion being maintenance and repair for long-term stay. In four breakout rooms, about sixty participants brainstormed various aspects of maintenance of a lunar landing and launch pad. The findings of this workshop will help us in charting a strategy for this important but underrated topic. The focus group is forming four sub-groups to streamline conversation with the community. The sub-groups are:

- Maintenance, Site Planning & Site Prep
- Technologies and Materials (additive construction, raw materials)
- Horizontal and Vertical Construction (LLP, berms, roads, habitats)
- Outfitting

We are looking for sub-group leads. If you are interested, please fill out the survey form below, which can also be used to express your interest in supporting a sub-group. The survey can be found at <https://docs.google.com/forms/d/e/1FAIpQLSerO0O8JYFMNOtkB4WJlumHW5vhfxdO32CBTeLZgEFOlemigQ/viewform>

### Extreme Access

At the October meeting, the EA group had updates on the fall LSIC meeting being held in November and from the PNT subgroup on recent activities, including gathering feedback on the NASA's proposed LunaNet Interoperability Standards. There was also a presentation from Ike Witte on Dragonfly Terrain Relative Navigation and how lessons learned there might apply to the Moon. At the November telecon, Sam Peterson from Swedish Space Corporation will be presenting on SSC's communications services for commercial lunar missions.

### Extreme Environments

The Extreme Environments (EE) Focus Group started a new, multi-month agenda to dig into the software and technology gaps/limitations we currently have that would prohibit building a sustainable lunar habitat. This new initiative was introduced at our monthly focus group meeting on October 12 as well as a featured presentation by Erin Hayward exploring all the space environmental effects testing capabilities at MSFC. During the remainder of this year, we will have updates from our subgroup leads and an overview of the fall meeting. We encourage everyone to document any thoughts, comments, information, etc. on our confluence page to keep a complete record for our mutual benefit. Keep a look out for plans of a workshop in the late spring. If community members have ideas for what they would like to see or discuss, please reach out to any member of EE leadership.

### ISRU

The ISRU Focus Group has continued to work on multiple fronts through Confluence, the breakout sessions within the monthly ISRU Focus Group meeting, and in community surveys. The evaluation of community needs for laboratory facilities and the ability for existing facilities to meet those needs is nearing completion, leveraging a combination of community surveys and the availability of multiple online databases of existing facilities. The findings on the effectiveness of the current NASA AO process for funding technology development from concept to flight that has been based upon and inspired by the ISRU community is also nearing completion. At our last Focus Group meeting on Oct 20, the Value Networking subgroup solicited input from focus group members on mutually beneficial technologies as part of the breakout group's effort of creating an organic value chain model for ISRU

technology development. Members are encouraged to fill out the survey here (<https://docs.google.com/spreadsheets/d/1AxV0-ueLwej2fgu1NgoX-BS-ANNU0e77XAXLMc6Xrq0/edit?usp=sharing>, especially the Supply Matrix tab). We heard a presentation on the LWIMS water-extraction study by Dr. Julie Kleinhenz, GRC. We also heard from Dr. Jeff Plate of WGM, Ltd. on potentially expected distributions of volatiles in PSRs. The subsequent breakout groups discussions continued upon these and other topics.

#### Surface Power

For October, the Surface Power team had a monthly telecon themed on power to “survive the night,” with presentations from USNC-Tech and Lockheed Martin on low-power radioisotope sources expected to reach TRL 6-9 over the next few years, and from Philip Lubin of UCSB on methods for survival informed by power beaming and cryogenic engineering. At the end of the meeting, we broke out to subgroup discussion topics, with conversations continuing in Miro on the next steps to take for each subgroup. These discussions will inform topics for our next focus group meetings (date TBD due to the Thanksgiving holiday). Contact [Wesley.Fuhrman@jhuapl.edu](mailto:Wesley.Fuhrman@jhuapl.edu) for access to the Miro discussion board!

# Feature Article

## Excavation And Construction Workshop Overview

On 20 August 2021, the Excavation and Construction (E&C) Focus Group held a 2.5-hour virtual workshop with 136 participants. The agenda included a presentation on NASA's assessment of E&C capability needs and technology gaps, a set of breakout rooms with a guided discussion capturing feedback from the community, and presentations on lunar simulants and lunar launching pads. In the breakout sessions, the community was allowed to respond to questions regarding the presented capability needs and technology gaps. The community was also asked questions regarding other topics such as power and high Technical Readiness Level (TRL) technologies. Recordings of the workshop and associated information can be accessed at the event website: <https://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=139>.

Government, Industry and Academia contributed to ~90% of attendees in roughly equal proportions with the remaining ~10% as non-Profit or other. Despite the variation in breakout room composition, the themes of the outcomes of the discussions were similar among all. The main takeaways from the breakout sessions are:

- (1) The top five topics the community wants more guidance from NASA and discussion on are requirement specification/standardization, tech/capability gap identification, material specification, power requirements, and maintenance/long-term plans.
- (2) Regarding CLPS missions, the community is interested in learning more about when payloads will be flown on CLPS missions that are aligned with E&C and how the data collected from these missions can inform the timeline for lunar E&C.
- (3) The community feels that more demonstrations on the lunar surface are needed, prominent among them concerning ground lunar survey composition measurements, underground exploration for habitats, laser power beaming demonstration and demonstration of repair bots. They also feel that power timeline needs to be shifted to the left.
- (4) Technologies developed by the fast emerging Autonomous Construction industry are likely high-TRL technologies that NASA should leverage. Similarly, automation technologies in the mining industry have made rapid strides (out of necessity) and should be utilized. Some of the other high-TRL technologies available that the community feels can be used for early development work include tele-operation with 2 sec latency and autonomous object detection using AI. In general, we feel that every effort should be made by NASA to exploit available high-TRL technologies.
- (5) The community feels that it is important to learn more about the exact details on the timeline for basic infrastructure and the order of construction of infrastructure elements.
- (6) Community wants more guidance on topics relevant to industry's involvement such as (administrative and logistical) mechanisms in place by which industry can get involved, how industry can attract investors and how much new spending is necessary from industry.

With all the information gathered in the breakout session, the E&C Team intends to follow up with discussions in future meetings for the Focus Group. The October meeting, for instance, consisted of breakout sessions to flesh out ideas related to maintenance and repair for long-term stays on the lunar surface. Additionally, the E&C Team is working on expanding collaboration across multiple other Focus Groups in the area of standardization that cuts across all capability areas. With power emerging as a prominent player in the discussions and given its importance, E&C team plans to work more closely with Power focus group that includes joint workshops and meetings. We have already started planning a joint workshop with ISRU focus group on supply and demand of in-situ metals.

# Member Spotlight

## satsearch

When asked to briefly describe the company satsearch, CEO Kartik Kumar has a ready response: “To sum it up, we’re building an Amazon for the space industry.” He acknowledges there’s a lot to unpack in that statement, but it distills down to creating an online marketplace for everything that touches the space industry, from ground and launch systems to space systems and applications. Kumar’s background is in space engineering, and he had worked with different companies and organizations on a variety of projects but always ran into the same problem – spending a lot of time Googling for parts, calling suppliers and trying to explain what was needed, exchanging technical and procurement information, as well as nailing down quotes and lead times. The constant struggle made him wonder – what if buying components for space engineering projects was like buying groceries online, where you could get what you need in just a few clicks? And that’s how he and his early collaborators Alberto Vaccarella and Narayan Prasad Nagendra, Chief Technology Officer and Chief Operating Officer for satsearch respectively, began to work towards finding a better way to buy and sell in the space industry.

Originally Kumar and Vaccarella weren’t envisioning creating a new company – they were just hoping to solve a problem they personally had struggled with. But when the opportunity arose in April 2015 to participate in a space-focused hackathon in Germany, they leapt at the chance to spend 72 hours eating, breathing, and sleeping their idea. During the event they built and launched the first version of their website and presented the idea to the 100 other participants. In doing so, they found that their own personal experience mirrored that of many others in the industry – though many they spoke to felt defeated by the problem, expressing that it was just ‘part of the job’ and there was no way to avoid it. Kumar and Vaccarella felt differently, though, and spent six months researching the problem further to determine if there was more to their idea than just a weekend project. In January of 2016, all their work led them to believe it was time to start a company to tackle this industry-wide problem, which is also when Nagendra joined the team.

Their enthusiasm was still met by skepticism from some of their peers – they agreed about the problem and understood the solution being presented, but dismissed it thinking that in an industry often known for closed-door operations, getting online participation would prove difficult. But the satsearch team challenged that idea. “I’m glad we did,” explained Kumar, “because what people didn’t realize was how vast the space sector is, all the global activity is going on, and how much people just don’t know about.” The current movement toward commercial space is exciting especially when you look at what Kumar describes as the ‘long tail’ of the industry. He gave the example of Rwanda, who just established their country’s space agency. While Rwanda may not be first to mind when it comes to space operations, recent SEC filings show they’re considering putting thousands of satellites into low Earth orbit. “Every month we have people from over 100 countries using our platform,” Kumar proudly stated. “If you’d ask me when we started how many space-faring countries there are I would have said a maybe two dozen. But it tops over 100 countries.” And to him, even for those just starting with simple systems like CubeSats, it’s an exciting genesis point for commercial space activity worldwide.

Grit (and perhaps some stubbornness) got them through some of the early pushback they experienced, and in 2018 an opportunity to participate in the ESA Business Incubation Centre arose. “It was invaluable to us and allowed us to graduate from an idea we thought could work to a business where we’re solving problems on both sides of the marketplace,” Kumar shared. The program ran for two years, and Kumar believes the experience also helped increase their credibility in the industry. And now, all those years of effort are paying off as those who were naysayers in the beginning are now coming to work with satsearch. Prime contractors and major players in the traditional space industry are using their platform. Each month over 12,000 individuals from more than 100 companies use the platform to purchase goods and services. Satsearch’s supplier database currently has over 2,000 participants offering over 6,000 products and services. Last quarter saw \$100 million dollars of potential contract value passing through the platform. “We’re off to the races, but have a lot of work to do still,” said Kumar.

Another defining characteristic has been their dedication to operating as an avidly neutral platform. Satsearch itself doesn’t buy or sell in the marketplace, and the platform is open to anyone looking to participate. From major organizations like ESA and NASA, to teams working out of their garage, and all the way back to publicly listed companies, everyone is welcome on satsearch. This approach aims to democratize the marketplace, opening it up to more buyers and sellers. And their welcome isn’t limited to traditional space sector companies, either. “I’m excited about looking at where there are ecosystems of expertise and capability in organizations who aren’t even thinking about the space sector yet,” Kumar shared. He sees enabling non-traditional organizations to enter the space industry as not just a ‘nice-to-have’, but vital in continuing the effort to commercialize space and make it accessible to everyone.

Even the global pandemic hasn’t been enough to stop organization’s growth, and may even have pointed more of their new participants to use satsearch’s digital platform to find what they need as more traditional venues like conventions were shut down. Currently there are five employees working completely remotely – each in a separate country. Kumar sees this as an advantage, though, because it has given the company an opportunity to build local relationships worldwide. “As we’re growing internationally, we want to know where different competencies and capabilities lie, then leverage that knowledge with where our team is already distributed.”

Recently Kumar has seen an uptick in lunar related procurement and selling on the platform as the Artemis program has made advances and people are really starting to believe that establishing a presence on the lunar surface is happening. Participating in LSIC has given the satsearch team an opportunity to talk to the community about looking at the lunar economy from a grassroots perspective, instead of solely focusing on a more traditional top-down analysis. Kumar has been participating in conversations in LSIC’s ISRU focus area about organic network and value chain analysis, trying to find opportunities for linking participants together to build the connective tissue that will hold together a commercialized space sector, giving firm footing to the developing lunar economy.

Visit satsearch for engineers: <https://satsearch.com/request>

Visit satsearch for suppliers: <https://satsearch.com/membership>

# NASA News

## NASA's Artemis Rover Passes Critical Design Review

27 October 2021: NASA's first lunar mobile robot, the Volatiles Investigating Polar Exploration Rover (VIPER) has passed its Critical Design Review (CDR), a critical milestone indicating that the rover has a completed design and has been approved by an independent NASA review board. The mission can now turn its attention to the construction of the rover itself, which will launch on a SpaceX Falcon-Heavy rocket for delivery to the Moon by Astrobotic's Griffin lander under NASA's Commercial Lunar Payload Services initiative. Click here to read more: <https://www.nasa.gov/press-release/ames/nasa-s-artemis-rover-passes-critical-design-review>

## Poland Signs Artemis Accords at IAC

26 October 2021: Poland has joined a growing list of nations affirming their commitment to ensuring sustainable space exploration by signing the Artemis Accords, which establish a common set of principles benefiting all of humanity. Grzegorz Wrochna, president of the Polish Space Agency (POLSA), signed the document Oct. 26 during a ceremony attended by NASA Deputy Administrator Pam Melory at the International Astronautical Congress (IAC) in Dubai, United Arab Emirates. Click here to read more: <https://www.nasa.gov/feature/poland-signs-artemis-accords-at-iac>

## NASA Commits \$28 Million to Underfunded US Jurisdictions

22 October 2021 (RELEASE 21-137): NASA has awarded \$28 million to fund the next five years of research infrastructure development across 28 jurisdictions. The Established Program to Stimulate Competitive Research (EPSCoR), a part of NASA's Office of Stem Engagement and based out of the agency's Kennedy Space Center in Florida, supports science and technology research and development at colleges and universities while also funding studies in Earth science, aeronautics, and human and robotic deep space exploration – all of which are disciplines critical to the NASA mission. Click here to read more: <https://www.nasa.gov/press-release/nasa-commits-28-million-to-underfunded-us-jurisdictions>

## NASA Completes Mega-Moon Rocket Stacking, Invites Media to Learn More

22 October 2021 (RELEASE 21-139): NASA has completed stacking of the agency's mega-Moon rocket and spacecraft that will launch the next generation of deep space operations, including Artemis missions on and around the Moon. Engineers and technicians successfully secured the Orion spacecraft atop the fully assembled Space Launch System (SLS) rocket at the agency's Kennedy Space Center in Florida just before midnight Oct. 21. Click here to learn more: <https://www.nasa.gov/press-release/nasa-completes-mega-moon-rocket-stacking-invites-media-to-learn-more>

## NASA Challenges Students to Design Moon-Digging Robots

20 October 2021 (RELEASE 21-136): NASA seeks young engineers to help design a new robot concept for an excavation mission on the Moon. The Lunabotics Junior Contest is open to K-12 students in U.S. public and private schools, as well as home-schoolers. The competition, which is a collaboration between NASA and Future Engineers, asks students to design a robot that digs and moves lunar soil, called regolith, from an area of the lunar South Pole to a holding container near where Artemis astronauts may explore in the future. Click here to read more: <https://www.nasa.gov/press-release/nasa-challenges-students-to-design-moon-digging-robots>

## NASA Announces Winners of Deep Space Food Challenge

20 October 2021 (RELEASE 21-135): Variety, nutrition, and taste are some considerations when developing food for astronauts. For NASA's Deep Space Food Challenge, students, chefs, small businesses, and others whipped up novel food technology designs to bring new solutions to the table. NASA has selected 18 U.S. teams to receive a total of \$450,000 for ideas that could feed astronauts on future missions. Each team will receive \$25,000. Additionally, NASA and the Canadian Space Agency (CSA) jointly recognized 10 international submissions. Click here to read more: <https://www.nasa.gov/press-release/nasa-announces-winners-of-deep-space-food-challenge>

## Lunar IceCube to Detect Water on the Moon

20 October 2021: Putting humans in space requires packing everything they need to survive aboard the spacecraft: food, water, clothing, even air to breathe. Using resources found on other planets can bring crewed missions within reach. NASA is now on a quest to identify water and other resources that can benefit the upcoming Artemis missions. "The Lunar IceCube is a CubeSat that will orbit the Moon searching for signs of water ice on the lunar surface that may be useful for Artemis and future exploration missions," said Terry Hurford, instrument scientist for Lunar IceCube's near-infrared point spectrometer. "If you were to send a crewed mission there, they would need drinking water, but water can also be used as a fuel source when broken down into hydrogen and oxygen." Click here to read more: [https://issuu.com/nasagsfc/docs/fall\\_2021\\_final\\_web\\_version/s/13713431](https://issuu.com/nasagsfc/docs/fall_2021_final_web_version/s/13713431)

## Surviving the Lunar Night: DRPS Could Enable the Power to Explore

12 October 2021: Dynamic Radioisotope Power Systems (DRPS) may enable lunar science payloads to survive and thrive during the harsh lunar night. New robust DRPS have been built and delivered by industry and are in the process of being tested at NASA's Glenn Research Center. In partnership with NASA's Radioisotope Power Systems Program, the Department of Energy's Idaho National Laboratory is in the process of procuring a system-level DRPS design for a lunar demonstration. This design will then be used to develop a brassboard to reach Technology Readiness Level (TRL) 5 (component or breadboard validation in relevant environment). Subsequent steps to build, qualify, and demonstrate the system will meet Presidential Policy Directive 6 (Space Policy). This in-space demonstration of dynamic conversion will enable NASA to make the next giant leap toward implementing higher-power nuclear power and propulsion solutions. Click here to read more: <https://science.nasa.gov/technology/technology-highlights/surviving-the-lunar-night-drps-could-enable-the-power-to-explore>

## NASA Releases Climate Action Plan

07 October 2021 (RELEASE 21-131): NASA released a climate action plan Thursday, Oct. 7, aimed at averting mission impacts due to climate change, ensuring the resiliency of facilities and assets, and providing the nation and world unique climate observations, analysis, and modeling through scientific research. The plan is part of President Biden's whole-of-government approach to confronting the climate crisis. Federal agencies face rising maintenance and repair costs due to more frequent and extreme weather events, health and safety challenges to employees for work outside, and potential issues with program effectiveness. To address these and other challenges, President Biden prioritized federal agency climate adaptation and resilience planning. Through this approach, NASA and 22 other large agencies developed climate action plans, to address their most significant climate risks and vulnerabilities. Click here to read more: <https://www.nasa.gov/press-release/nasa-releases-climate-action-plan>

## NASA Seeks Commercial Spacesuit Services Proposals

*06 October 2021:* NASA published a request for proposal (RFP) Sept. 29 for companies to compete for the agency's future purchase of spacesuits and support services for spacewalks on the International Space Station, during Artemis lunar surface missions, and as needed on Gateway in lunar orbit. Building on more than 55 years of lessons learned during spacewalks, Johnson Space Center will continue NASA's in-house risk reduction effort by testing the current exploration spacesuit design - known as the Exploration Extravehicular Mobility Unit, or xEMU - in parallel with the services procurement. NASA will make data available for use by commercial companies from its design and development work. By uniting with commercial industry partners, the space economy will expand and propel forward, ultimately revolutionizing the human experience in space. Click here to read more: <http://spaceref.biz/agencies/nasa-seeks-commercial-spacesuit-services-proposals.html>

# Funding Opportunities

## Tech Development

- NASA Innovative Advanced Concepts (NIAC) 2022 PHASE 2 Call for Proposals  
<https://www.nasa.gov/content/apply-to-niac>

Phase 2 Due: December 12th, 2021

- NASA Human-Autonomy Teaming Task Battery Challenge  
<https://www.nasa.gov/nasa-hattb>

Deadline: December 29, 2021

- 2022 Breakthrough, Innovative and Game-Changing (BIG) Idea Challenge: Extreme Terrain Mobility Challenge  
<http://bigidea.nianet.org/competition-basics/>

Proposal and Video deadline: January 18, 2022

## Student Tech Development

- NASA Space Technology Graduate Research Opportunities (NSTGRO22)  
<https://nspires.nasaprs.com/external/solicitations/summary.do?solId={16FBBBCE-FF26-3208-38A5-447B00A8EE7D}&path=&method=init>

Proposals due: November 2, 2021

- NASA TechRise Student Challenge  
<https://www.nasa.gov/press-release/new-nasa-student-challenge-offers-hands-on-tech-development>

Submission Deadline: November 3, 2021

- Over the Dusty Moon Challenge (Colorado School of Mines & Lockheed Martin)  
<https://www.overthedustymoon.com/>

Webinar Nov 29, 2021: Deadline for entries Dec 20, 2021: Notification to invitee teams for in-person challenge June, 2022: In-person challenge

- Breakthrough, Innovative and Game-changing (BIG) Idea Challenge  
<http://bigidea.nianet.org/>

Proposals are due Jan. 18, 2022

For more funding opportunities, please visit LSIC's website here: <http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php>