Lunar Surface Innovation CONSORTIUM

LSIC Newsletter Volume 2 Issue 6 - June 2021

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.

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Director's Update

Thank you so much to everyone who was able to join us for the Spring Meeting! For those who were not able to make it, the videos of each segment are now available on the meeting website (http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=124). It was great to hear from the different speakers and panelists, as well as to see all of the exciting work that the community is up to. Personally, I really enjoyed the getting to talk with people at the poster session and in the breakouts to understand how we can help the community grow and succeed. The Confluence pages for the breakout sessions are still available, so anyone is welcome to visit those and contribute to the discussion.

We will be using the feedback gathered during the breakout sessions as well as the post-meeting survey (https://forms.gle/GEptW1akBPDn3YMw8) to assess and, where necessary, tweak our plans for the upcoming year. One of the take-homes that I have is that increasing our networking opportunities would be welcome. Since we have members with a range of different backgrounds and concerns involved, it is helpful to get smaller groups together to discuss the big picture from different angles. We will be looking into how to approach this over the next few months, and considering options like dedicated networking sessions, a Gather space to meet in more regularly, etc. I encourage folks to continue to use Confluence for discussions and networking as well. Though, one note—if you are new to Confluence and have not yet found the setting, please check your top right corner for an eyeball icon that says either 'Watching' or 'Watch'. As at least one member found out (per their survey), if you have it set to 'Watching', you will receive emails when people post to the page, or even the whole site (depending on the exact setting). All you need to do is click the eyeball and change the setting and you can select whether you want to receive updates or not.

That's all for now, I hope everyone has a wonderful summer!

Rachel Klima
Director, Lunar Surface Innovation Consortium
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Focus Area
Monthly Telecon Schedule

If you'd like to participate in a focus area's monthly telecon, please sign up on the LSIC website here: lsic.jhuapl.edu/Events/survey.php

Dust Mitigation
Third Thursdays at 12PM Eastern

Excavation & Construction
Last Fridays at 3PM Eastern

Extreme Access
Second Thursdays at 3PM Eastern

Extreme Environments
Second Tuesdays at 3PM Eastern

In Situ Resource Utilization
Third Wednesdays at 3PM Eastern

Surface Power
Fourth Thursdays at 11AM Eastern

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A preflight view of the Ultrasonic Tweezers handle trapping a polystyrene sphere during hardware verification. The objective of the Ultrasonic Tweezers project is to develop acoustic tweezers that use sound to allow for remote and contactless manipulation of materials in a microgravity context. Image courtesy of CNES/T. De Prada.

ISRU Focus Group Networking Meeting 16 June 2021

The June focus group meeting for ISRU will be held on 16 June. Twenty five one-minute videos introducing members of the LSIC ISRU community will be shared with the group for viewing on their own time. The majority of the meeting itself will be spent in Zoom breakout rooms talking with others. Some themes for discussion could include: 1) Scouting for water in PSRs; 2) Processing water from PSRs; 3) Oxygen from regolith; 4) Partnerships between small and established organizations; 5) Earth-based Facilities. Assignments will be random, but after spending some time in your group, you have the option of leaving for different breakout session. For information about how to join the session, please email Andrea Harman at ams573@alumni.psu.edu.

Science & Technology Policy Institute (STPI) Report Released

U.S. human space endeavors are focused on a return to the Moon, with an initial landing of U.S. astronauts expected in the 2020s. Some in the space industry have argued that a return to the Moon may lead to the creation of a more commercially oriented lunar economy. In "Demand Drivers of the Lunar and Cislunar Economy," STPI examined the contours and future scale of demand drivers of lunar and cislunar activities through 2040 to ascertain whether private sector demand could support commercial lunar activities. Their focus was on non-NASA commercial demand. The report is available for review here: https://www.ida.org/research-and-publications/publications/all/d/de/demand-drivers-of-the-lunar-and-cislunar-economy

Feature Article: **LSIC Spring Meeting Review**

The Lunar Surface Innovation Consortium (LSIC) 2021 Spring Meeting was held on May 11-12, 2021. The objective of this meeting was to bring together NASA and the space technology community, including commercial and non-profit industry, academia, and government, to discuss the efforts and accomplishments of LSIC and key concerns for establishing a sustained presence on the lunar surface. Attendance included 546 people representing over 200 institutions that met over the course of two days. Roughly half (49%) of those who registered for the meeting had not previously attended an LSIC event, and over half (53%) have never worked with NASA's Space Technology Mission Directorate.

The meeting featured a keynote address from the NASA Senior Advisor for Budget and Finance, Dr. Bhavya Lal, and presentations by Jim Reuter, NASA Associate Administrator for Space Technology, as well as Joel Kearns, Deputy Associate Administrator for Exploration in NASA's Science Mission Directorate. Consortium updates were given along with a panel discussion featuring several members of the LSIC Executive Committee constructively discussing how LSIC can engage new members and ensure that its mission is focused on key technology advancement as well as community development. Other panels discussed Space Tech funding opportunities, highlighted several projects that had been recently selected through different programs, and considered how technology enables lunar science, exploration, and commerce.

Breakout sessions provided a chance for the community to discuss critical needs in more detail. Four of the breakout sessions centered on areas of interest identified by the LSIC community over the last year, as well as consortium goals and activities. These were: (1) focus group goals and cross-group integration; (2) issues regarding standardization (e.g., what to and what not to standardize); (3) technology readiness and demonstrations; and (4) consortium growth, community building, and mentoring. The objective of these sessions was to engage participants directly in small-group discussions to address their needs and concerns, and to adjust the goals and activities for LSIC and the focus groups, as appropriate. The fifth (5) breakout session provided an opportunity for the LSIC community to speak directly to the NASA leads for the Watts on the Moon Challenge to discuss crafting the second phase of this challenge and to raise awareness for it among the community.

Findings from the breakout sessions included:

- Triage is important with respect to technical readiness evaluation/testing. The breakout group suggested that *LSIC could help the community and NASA by coming to a consensus on where Earth and space-based testing facilities are adequate for testing lunar technology, then determine which mission components absolutely have to be tested in-situ.*
- While standardization is a concern to ensure interoperability, safety, and sustainability, there is a need to avoid standardization with a top-down approach that may stifle creativity. *However, standardizing or channelizing development can save companies money and advance TRL more rapidly. Therefore, developing community consensus on key areas of standardization that are more likely to benefit the community as a whole and maintain innovation should be identified.*
- For smaller businesses, proposal opportunities are more accessible if they require low up-front burdens to pitch initial ideas. Techniques used by groups such as AFWERX should be examined when trying to stimulate commercial investment and engagement. *Where beneficial, LSIC should determine how to leverage these existing programs and tools to help cultivate the applicable lunar technical endeavors in each sector.*

Member Feature: **Melissa Roth, Off Planet Research**

In 2015, two undergraduate mechanical engineering students at Saint Martin's University started a senior project. Their efforts centered on how to develop the processes required to make lunar and other extra-terrestrial simulants. From this beginning, Off Planet Research (OPR) was established in Lacey, Washington. Those students, now Co-Owners and Lead Researchers Melissa Roth and Vince Roux, had an objective that was (and continues to be) "creating unique and sought-after simulants from extra-terrestrial environments for testing space technology and conducting research and development." The company now offers five standard lunar simulants (with custom simulants and agglutinates available upon request) and offers lab space for rental, with an experienced and growing staff. In fact, OPR's expansion now sees the team moving their headquarters to Everett, WA where they will be in Boeing's backyard, surrounded by several other space companies in the Seattle area.

"We're best known for our lunar regolith simulants," said Roth, "but we also provide component and in-house testing for organizations who don't have their own facilities or the experience required." OPR has also been building capacity for icy regolith simulants specifically as test material for the upcoming Artemis missions. The company recently received a National Science Foundation (NSF) Small Business Innovation Research (SBIR) award to continue expanding their work in this area, and they are planning to make their work on such simulants more scalable and portable. "Right now we can make small batches in-house, but we recognize that organizations need much more than our current kilogram scale, and they can't always travel to us to use it," she explained.

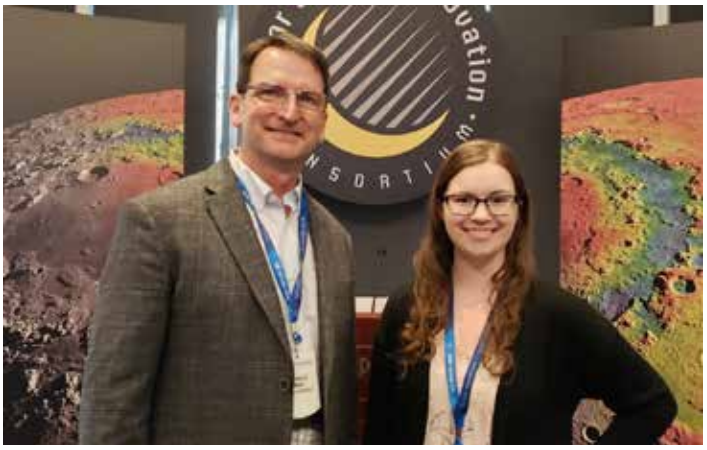
When asked about OPR's future growth and development, Roth shared, "We really want to expand our simulant and test repertoire. In five to ten years I hope there's enough interest and activity with other planetary bodies that we can have simulants for the icy portions of Mars, other asteroids, and various moons." Another goal for the company is to continue building their testing capabilities for more full-scale technologies. While their lab is currently in transit with their move, once OPR's presence in Everett is established they will resume rentals and component testing for clients.

Roth has also been leading the Regolith and Surface Interface subgroup of Lunar Surface Innovation Consortium's Extreme Environments focus area. "We're always looking for new members who want to participate," she shared. Currently the group is working on an informational resource guide, which can be accessed in its in-progress state on LSIC's members-only Confluence wiki. According to their purpose statement, the document will focus on the properties of regolith and surface interface, and their effect on surviving and operating on the Moon. "We want to make it available to students and early career scientists, and build it from ongoing community input," Roth asserted.

When thinking about those in the early stages of their careers, academically or professionally, Roth's advice is to jump into attending events and meetings. "The biggest thing is to attend conferences. I think that is the best way to network, the best way to learn. You'll be Googling on your phone what something's background is, but it's a great way to become immersed in the community – it enables you to hear from and interact with people who have been in the industry for decades." Roth and other OPR representatives have also given talks at educational organizations and schools aimed towards getting the next generation ready and enthusiastic about space.

Taking a wider view of the lunar surface development community, Roth finds getting non-space companies involved to be most interesting. “There’s so much we’re going to need – if we don’t have to develop it from scratch, we’ll save time, energy, and resources,” Roth declared. Utilizing knowledge and technologies that already exist on Earth, and making them Moon or space compatible, is something Roth will continue to advocate for as she moves forward in her career with OPR.

Find out more about the Regolith and Surface Interaction subgroup that Melissa Roth leads! Registered LSIC participants can access information about their work on the Confluence wiki here: https://lsic-wiki.jhuapl.edu/x/x4MZ (If you need access to the wiki, please contact Andrea Harman at ams573@alumni.psu.edu).



Vince and Melissa attending the Lunar Surface Innovation Consortium Conference in February 2020.

Highland Simulant pouring from hands.

Community Bulletin Board

NASA SBIR Wins For Paragon SDC’s ICICLE and MOVE

Submitted by Ryan Kobrick, Paragon Space Development Corporation

Paragon Space Development Corporation has had some recent NASA SBIR wins! One is a Phase II for ISRU (ICICLE), and the other is a Phase I on active / passive dust mitigation (MOVE). Additional details about these two projects are listed below.

ICICLE: ICICLE is an In-Situ Resource Utilization (ISRU) platform that is dedicated to advancing human spaceflight operations into deep space and establishing a long-term human presence on the Moon and Mars. It is designed to support the generation of potable water by simultaneously collecting and purifying water vapor from lunar ice collected via a wide range of lunar ice mining techniques. Click here for more information: https://www.prnewswire.com/news-releases/paragon-space-development-corporation-awarded-two-new-nasa-contracts-301296744.html

MOVE: Paragon was recently awarded a NASA SBIR Phase I contract for Modal Optimized Vibration dust Eliminator (MOVE) as a low cost solution to for dust mitigation on the lunar surface. Vibrational excitation at targeted modal frequencies can mitigate dust adhesion with the assistance of passive dust mitigation coatings. Click here for a proposal summary: https://sbir.nasa.gov/SBIR/abstracts/21/sbir/phase1/SBIR-21-1-Z13.01-2510.html

NASA Awards $500K in First Phase of $5M Watts on the Moon Challenge

Submitted by Karen James, NASA

Winners of the Watts on the Moon Challenge, a competition challenging U.S. innovators to develop breakthrough energy storage and use technologies that make longer-lasting Moon missions, and the discoveries they uncover, were announced! Sixty teams submitted original design concepts aimed at meeting future needs for robust and flexible technologies to power human and robotic outposts on the Moon. After evaluation by a judging panel, NASA announced the winners during a private awards ceremony.

The winning teams are:

- Astrobotic Technology, Inc. of Pittsburgh: $100,000
- Planetary Surface Technology Development Lab at Michigan Technological University in Houghton, Michigan: $100,000
- Skycorp Inc. of Santa Clara, California: $100,000
- Astrolight of Rochester, New York: $50,000
- KC Space Pirates of Kansas City, Missouri: $50,000
- Moonlight from the University of California, Santa Barbara: $50,000
- Team FuelPod of Johnstown, Colorado: $50,000

Learn about the winning submissions and Phase 2 of the competition here: https://www.nasa.gov/directorates/spacetech/centennial_challenges/500k-awarded-in-first-phase-of-5m-watts-on-the-moon-challenge.html

Skidmore, Owings and Merrill at Venice Architecture Biennale 2021

Submitted by Daniel Inocente, Skidmore, Owings and Merrill

Skidmore, Owings & Merrill (SOM) will bring its vision for a Moon Village to the 17th International Architecture Exhibition of La Biennale di Venezia in an installation entitled Life Beyond Earth. Developed in partnership with the European Space Agency (ESA), the installation will showcase SOM and ESA's proposal for a new type of space architecture – a sustainable ecosystem that will support a human presence on the Moon in the decades to come. Click here to view their listing at La Biennale, and click here to read the article about their presence at the event. "The 'Life Beyond Earth' exhibit envisions a potential future for lunar settlement that would be achieved through international cooperation. The project is a cross-sector partnership between the European Space Agency and SOM formed to address the challenges of long-term human space exploration and development. A new type of habitat architecture is presented as a solution to creating environments that center on the human aspects of exploration. I am thrilled and honored to have our work on display at the Venice Architecture Biennale 2021" Daniel Inocente, Senior Designer at SOM.

Astrobotic Selected As Phase 1 Winner Of NASA's Watts On The Moon Competition

Submitted by Mike Provenzano, Astrobotic

Congratulations to Astrobotic for being selected as a Phase 1 winner of NASA's Watts on the Moon competition and for their recent Phase 2 SBIR award that continues their development of wireless charging systems for the Moon! The architectures and technologies developed in these opportunities when combined with Astrobotic's recent VSAT Phase 1 contract award last month and its existing rovers in development, will ensure that a much needed flexible power infrastructure can be operated on the Moon reliably, affordably, and soon (on an upcoming CLPS mission).

PTMSS/SRR Final Agenda And Registration

Angel Abbud-Madrid, Colorado School of Mines

Just a reminder to register for the 11th joint meeting of the Planetary & Terrestrial Mining Sciences Symposium (PTMSS) and the Space Resources Roundtable (SRR), which will be held virtually on June 8-11, 2021. The meeting will be hosted by the Canadian Minerals and Metals Plan Secretariat. As seen in the Final Agenda, there will be technical presentations and roundtable discussions on a wide variety of topics related to space resources, including all current destinations (cislunar space, Moon, asteroids, Mars), space commerce, space law and policy, and ISRU technologies from space agencies, the private space sector, the mining industry, international organizations, and academia.

NASA News

New NASA Student Challenge Offers Hands-On Tech Development

25 May 2021 (RELEASE 21-069): NASA will initiate a new competition for the 2021-22 school year, providing student teams a chance to design, build, and launch experiments on suborbital rockets and high-altitude balloon flights. NASA and Future Engineers, the challenge administrator, will offer a series of virtual events for educators to hear from agency experts and learn more about this exciting opportunity for students. The NASA TechRise Student Challenge will begin accepting entries in August. Teams of sixth- to 12th-grade students can submit ideas for climate or remote sensing experiments to fly on a high-altitude balloon, and space exploration experiments to fly aboard a suborbital rocket. Click here to read more: https://www.nasa.gov/press-release/new-nasa-student-challenge-offers-hands-on-tech-development

3 Students Named Winners of Artemis Moon Pod Essay Contest

19 May 2021 (RELEASE 21-065): NASA has named three students the winners of the Artemis Moon Pod Essay Contest for their creative visions of a pioneering journey to the Moon. Nearly 14,000 students entered the contest, each competing for the grand prize: a trip to NASA's Kennedy Space Center in Florida, where they will witness the first launch of the Artemis era. Click here to read more: https://www.nasa.gov/press-release/3-students-named-winners-of-artemis-moon-pod-essay-contest

NASA Invests $105 Million in US Small Business Technology Development

13 May 2021 (RELEASE 21-064): NASA has a long history of supporting America's entrepreneurs as they develop technologies from ideas to commercial readiness. The agency's Small Business Innovation Research (SBIR) program is furthering that legacy with 140 new Phase II awards to 127 U.S. small businesses that will help them move their innovations to market. The awards to these small businesses, located across 34 states and Washington, D.C., total $105 million. NASA's small business program is dedicated to finding the most useful technologies for the agency and the commercial marketplace, and sourcing those innovations from a diverse group of entrepreneurs with different backgrounds and perspectives. The companies chosen for Phase II funding include 33 women-owned, minority-owned, and veteran-owned small businesses. Click here to read more: https://www.nasa.gov/press-release/nasa-invests-105-million-in-us-small-business-technology-development

Funding Opportunities

TECH DEVELOPMENT OPPORTUNITIES

MUREP-Small Business Technology Transfer Research Planning Grants (M-STTR)
https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7BAB2C6494-0726-903C-AE4E-239F613BEBBF%7D&path=&method=init
Submission Deadline: June 11, 2021

Break the Ice Challenge
https://www.nasa.gov/directorates/spacetech/centennial_challenges/break-the-ice/index.html
Phase 1 Registration and Submission Deadline: June 18, 2021

NLRA 2021-5: In-Space Production Applications: Advanced Manufacturing and Materials
https://www.issnationallab.org/research-on-the-iss/solicitations/nlra2021-5/
Step 1 Proposals Due: May 6, 2021; Step 2 Proposals Due: July 12, 2021

SpaceTech-REDDI-2021 - Early Stage Innovations
https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7BC6DCCA8A-494B-FBE5-8503-8A969034C818%7D&path=&method=init
NOI Due: May 26, 2021 at 5:00pm ET; Proposal Due: June 28, 2021 at 5:00pm ET

Deep Space Food Challenge
https://www.nasa.gov/directorates/spacetech/centennial_challenges/spacefood/index.html
Phase 1 Registration Deadline: May 28, 2021; Submission Deadline: July 30, 2021

STUDENT TECH DEVELOPMENT OPPORTUNITIES

NASA Fellowship Activity 2021
https://nspires.nasaprs.com/external/solicitations/summary!init.do?solId=%7b24E3CA0D-F71B-03FF-AD0E-AB283B3B1050%7d&path=open
Due: July 19th, 2021

NASA Fellowship Activity 2021: Minority Serving Institution Fellowships 2021
https://nspires.nasaprs.com/external/solicitations/summary!init.do?solId=%7b24E3CA0D-F71B-03FF-AD0E-AB283B3B1050%7d&path=open
Due: July 19th, 2021

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