



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.

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Director's Update

Hello LSIC Community!

I have a couple of quick updates to share this month. First of all, as you have hopefully seen, we have moved our Spring Meeting dates to April 24-25th. With this comes an extension in the deadline for the abstracts, which are now due on February 15th. We are working through the program now, but are happy to share that we will be welcoming NASA Deputy Administrator, Pam Melroy, to present a keynote talk on the second day of the meeting. The meeting itself will focus on the United States, NASA, and Space Tech's vision for a sustained presence on the lunar surface. Panels, discussions, and working sessions will include topics such as long-term use cases for infrastructure on the lunar surface, technology developments, and creation of a white paper to capture the community's perspective on the infrastructure and technology developments needed to support transition from a mostly NASA-supported presence to industry or other public or private participants. Registration should open soon, and will be accessible through the meeting webpage here: <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=380>.

In preparation for the transition to industry discussions, the LSIC team has been putting together a draft white paper that summarizes some of the input that we have received of the past several years. The goal of this is to provide a concise, readable summary of how and where industry might begin to take the handoff of providing different services at the Moon. It is meant as a framework for identifying where system level demonstrations (on the Moon or in simulated lunar conditions) are critical, where key investments could enable large advancements, and what aspects need to be considered now. This draft will be shared with the community and discussed in detail at the Spring Meeting, so that feedback can be incorporated.

To the Moon!



Rachel Klima

Director, Lunar Surface Innovation Consortium

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Focus Areas

Monthly Telecon Schedule

Dust Mitigation (DM)

Third Thursdays at 12PM Eastern

Extreme Access (EA)

Second Thursdays at 3PM Eastern

In Situ Resource Utilization (ISRU)

Third Wednesdays at 3PM Eastern

Excavation & Construction (E&C)

Fourth Wednesdays at 2PM Eastern

Extreme Environments (EE)

Second Tuesdays at 3PM Eastern

Surface Power (SP)

Fourth Thursdays at 11AM Eastern

LSIC General Updates

As a reminder, If you don't have access to LSIC's Confluence wiki, please email SES-LSIC-Web@jhuapl.edu to get signed up.

Focus Group Updates

Dust Mitigation

The Dust Mitigation (DM) Focus Group held its first monthly focus group meeting of 2023 on January 19th. We kicked off an exciting 2023 year with a featured presentation by Dr. Joel S. Levine, Research Professor at The College of William and Mary, and Member of the Space Environment Technical Discipline Team at the NASA Engineering and Safety Center (NESC). He presented on "The Impact of Lunar Dust and Mars Dust on Human Exploration: A review of the NASA Engineering and Safety Center (NESC) Workshops." In addition, we also discussed monthly LSIC updates, upcoming opportunities, and provided an update on our Dust Mitigation subgroups. If you are interested in leading or joining a Dust Mitigation Subgroup, please fill out our survey: <https://forms.gle/AGpyJcNZBd6ihdaq7>.

Some items to look forward in early 2023 include joint focus group meetings with other focus groups, the LSIC White Paper on establishing a sustained lunar ecosystem, and the LSIC Dust Mitigation workshop sometime in the Spring. The Dust Mitigation workshop will build on the successful 2021 Dust Mitigation workshop and bring together key stakeholders in Government, Industry, Academia, and Non-profit to understand the current state of dust mitigation across stakeholders, identify any challenges and gaps, and identify priorities, opportunities, and areas in need of future investments.

You can view the recording, slides, and notes from January's DM FG meeting and previous meetings at our LSIC Dust Mitigation Focus Group page on the LSIC website: <https://lsic.jhuapl.edu/Our-Work/Focus-Areas/index.php?fg=Dust-Mitigation>.

Our next focus group meeting will be held on Thursday, February 16th at 12:00 pm Eastern Time. The meeting will include featured technology presentations along with a discussion session. We look forward to seeing you then!

Excavation & Construction

In January, the Excavation and Construction (E&C) Focus Group hosted a meeting discussing recent imaging of Shackleton Crater by ShadowCam on the Korean Pathfinder Lunar Orbiter (KPLO) and early infrastructure concepts. We were joined by guest speakers John Mankins, VP of the Moon Village Association (MVA) and Co-Lead of their Architectural Concepts Working Group, as well as Dr. Karl Hibbitts, a planetary scientist at the Johns Hopkins University Applied Physics Laboratory (JHU/APL), followed by breakout sessions into our four subgroups: [Autonomy & Site Planning](#), [Additive Manufacturing & Raw Materials](#), [Site Prep, Horizontal & Vertical Construction](#), and [Outfitting & Maintenance](#).

You can connect with the E&C community anytime on Confluence - check out our [subgroups](#) and the [Who's Who](#) directory, linked here for your convenience.

Extreme Access

At the main telecon, we continued our series introducing the NASA SBIR/STTR process with a presentation from Sonia Vohnout of OppsSpot. Our various subgroups also kept busy. The PNT subgroup hosted John Carrico of Space Exploration Engineering for a two-hour workshop on lunar trajectory design. The Comms subgroup had a presentation from Erik Luther of Cesium Astro. The PNT paper reading group discussed “Lunar Navigation Beacons: Technology Development and Applications,”. And the Mobility subgroup met on January 26. We also held a special joint telecon with the Modular Open Systems Approach (MOSA) working group on Open Source/Open Standards in aerospace.

For February, we are looking forward to a presentation on VIPER path planning at the main EA telecon. We are also planning some SBIR/STTR “office hours” to provide assistance to community members with proposal questions.

Extreme Environments

Extreme Environments (EE) kicked off 2023 with a meeting covering past STTR calls. The 2023 SBIR/STTR calls are out, and our community members are interested in discussing those in February while the solicitation is still open. So, that is exactly what we are planning to do! Going forward in 2023, EE leadership would love to know what specific technology development awardees you would love to hear from in our showcase. Also in 2023, we are looking to combine some of our subgroup meetings to discuss crosscutting subject matter. As always, if community members have ideas for what they would like to see or discuss, please reach out to any members of EE leadership.

ISRU

We’re excited to start 2023 strong, including revamping subgroups and post-meeting discussions, as well as encouraging more cross-Focus Group thought and presentations. The ISRU Focus Group had two presentations during our January monthly meeting, both of which discussed detecting and locating water ice at the South Pole. We heard from Lior Rubanenko (Stanford) on “The abundance of subsurface ice near the lunar poles: lessons learned from the Moon and Mercury”, and Anicia Arredondo (SwRI) on “Detecting molecular water on the lunar surface through MIR spectroscopy”. Afterwards, during our Coffee & Donuts Discussion, we discussed the community-driven white paper, specifically how ISRU should be reflected and represented throughout the document. If you weren’t able to attend and contribute your input, please add a comment to the dedicated Confluence page, and we’ll make sure it’s captured: <https://lsic-wiki.jhuapl.edu/x/PQUiAw>. For our February monthly meeting, we intend to take a deep dive into the future of ISRU, where our Focus Group will go in 2023, and specifically what aspects of ISRU we want to prioritize this year. Be sure to attend to have your voice heard!

Surface Power

In January, the Surface Power team hosted a fission surface power (FSP) themed telecon. The telecon focused on NASA’s FSP Phase 1 awards to develop initial concepts for a 40 kWe lunar fission power system that weighs less than 6,000 kg and is capable of operating for 10 years. Representatives from each of the three Phase I awardees, in addition to NASA’s Power Division Associate Chief Lee Mason spoke at the telecon. The company presenters included Peter McGrath (Intuitive Machines; Vice President of Business Development), Joe Halackna (Westinghouse; Deputy Director for Reactor Engineering) and Mikaela Blood (Lockheed Martin; FSP Reactor Lead). After

the presentations, the four speakers participated in a panel discussion and answered questions submitted by the community.

On February 23rd, the Surface Power team will host a telecon focused on the topic of laser power beaming on the Moon, and the potential of a ~100 W-scale demonstration mission utilizing current, high-TRL technology. The speaker for the event will be Mark Storm, Director of NASA programs at Fibertek. Additionally, the APL Surface Power team is organizing a telecon on March 16th focused on the topic of radiation effects on electronics, and is utilizing community inputs derived from December survey results to plan summer workshop.

Working Group – Modular Open Systems Approach (MOSA)

On January 24th 2023, EA and MOSA teamed up for a special two-hour telecon on Open Source/ Open Standards in the aerospace industry. We heard from six speakers on the positives, barriers, and important considerations and recommendations for how to move forward with Open Source in aerospace. You can catch the replay of this event on the LSIC website.

On Wednesday, February 1st 2023 at 1:00 PM ET, Jaret Matthews, from Venturi Astrolab, will be presenting on their [Payload Interface Guide](#). The guide will educate potential partners and customers on the FLEX rover's capabilities and how it accommodates payloads. Astrolab believes this will ultimately lead to a vibrant lunar economy, in much the same way that intermodal standardized payload containers have become essential to trade on Earth.

Working Group – Simulants

The LSIC Lunar Simulants WG officially published the 2022 Lunar Simulants Assessment and it is now available on the LSIC [webpage](#) (under Assessments and Databases tab) and on the LSIC [Confluence](#) (scroll down, near the bottom of the left column). In addition, we have incorporated the results into our Simulants data portal called the [Lunar Simulants Data Repository](#). In this portal, we display annual assessment results for each simulant by year. In 2023, we will be expanding the role of the [Lunar Simulants Working Group](#) (LSWG) – we would like to start having meetings featuring community talks about simulant projects. If you are interested in learning more about simulants and ongoing simulants research within our community, please join up with the LSWG by going to the [LSWG confluence page](#) and click “Watch” in the top menu bar. Once you've done that, please go to the [Welcome page](#) and introduce yourself!

Feature Article

National Cislunar Science and Technology Strategy, A Landmark Document for the LSIC Community

By: Wes Fuhrman, LSII Lead

In November of 2022, shortly after our LSIC Fall Meeting, The Office of Science and Technology Policy (OSTP) released the first-ever [National Cislunar Science & Technology Strategy document](#). This document was a product of the Cislunar Technology Strategy Interagency Working Group, with representation across an enormous breadth of governmental stakeholders, including NASA as well as the Departments of Commerce, Defense, Energy, State, the National Science Foundation, United States Geological Survey, National Security Council, National Space Council, Office of Management and Budget, and OSTP. In an efficient 13 pages it provides excellent insight on national priorities in Cislunar space, explicitly defined in the document as “including the lunar surface.” While this may not seem like much, this four-word clause explicitly ties the lunar surface to discussions of cislunar space.

Production of this document involved extensive outreach to the community, including input from many LSIC members, including APL. It was released during the 3rd annual [APL Cislunar Security Conference](#), which featured a keynote presentation from Matt Daniels, Chair of the Cislunar Technology Strategy Interagency Working Group and Assistant Director, OSTP. The conference also included a keynote from NASA Deputy Administrator, Pam Melroy, and a presentation from the APL Project Manager for LSII, Brenda Clyde, as well as many other LSIC members. This shared interest in cislunar across agencies has also been corroborated by the recent announcement of collaboration between NASA and DARPA on nuclear thermal propulsion in cislunar space ([DRACO, Demonstration Rocket for Agile Cislunar Operations](#)).

This “whole of nation” interest in the Moon and Cislunar space will also be featured in the LSIC Spring Meeting, so keep a close eye out for more details on the developing agenda! These developments show the momentum towards a shared cislunar future and an acknowledgement that none of us can achieve our individual goals if we do not work in concert. The OSTP report calls out this collaborative future explicitly:

“In addition to government space programs, many other kinds of entities (spanning commercial, non-profit, and academic actors) are also expected to be operating in Cislunar space in the years ahead. The vision articulated in this document is designed to engage and be relevant to all space-faring entities as part of advancing a sustainable “Cislunar ecosystem.”

The report featured some key content related to lunar surface technologies, and the objectives presented are broadly consistent with LSII key objectives. It emphasized that we “build early technology ecosystems based on cooperation around shared values” and presented these in four main categories:

- Obj 1: Support research and development to enable long-term growth in Cislunar space.
- Obj 2: Expand international S&T cooperation in Cislunar space.
- Obj 3: Extend U.S. space situational awareness capabilities into Cislunar space.

- Obj 4: Implement Cislunar communications and positioning, navigation, and timing capabilities with scalable and interoperable approaches.

Objective 1 most clearly maps to the priorities of LSII/LSIC, specifically identifying an enduring presence of humans in cislunar space and the technology and workforce that will be needed to support human presence as well as science and exploration. Common topics of discussion within LSIC were mentioned explicitly, such as refuellable Lunar landers, lunar surface power systems, dust mitigation, surface mobility in extreme environments, and sustainable habitats. ISRU also gets some specific attention, both in resource assessment and the use thereof:

- “Lunar resource assessments, as well as the advancement of research, development, and demonstration of capabilities for using materials sourced from the Moon and other celestial bodies.”
- “U.S. government, in collaboration with private entities, will demonstrate the ability to use the products created by these capabilities to enable an enduring human or robotic presence on the Lunar surface.”

While many Lunar enthusiasts are wary of a pivot away from the Moon as a priority, it is expected to have essential utility in achieving additional deep-space exploration goals, ensuring that the transition will not be instantaneous.

- “Long-duration Lunar exploration missions should be designed to provide insight on these factors that would clarify requirements and mitigation techniques for missions to Mars and other destinations across the Solar System, as well as enable enduring human presence on the Moon”

In addition to the 6 focus areas being represented (directly or indirectly) in technologies called out in this report, the call to interoperability should also resonate with those in our community who have long called for this urgent call for attention to the topic:

- “Near-term Cislunar enabling capabilities will need to be transparent, open, interoperable, and scalable to advance a Cislunar ecosystem that is sustainable for years to come.”

Given that our LSIC community is now world-wide, the call for international engagement should also be noted. The expansion of international S&T cooperation in Cislunar space is recognized as key to “Achieving a peaceful, sustainable Cislunar ecosystem”

Finally, while space situational awareness has not been a primary topic of discussion, this document does call out lunar-based sensors for this purpose, with significant cross-over of interests, “The United States will pursue Cislunar SSA sharing with international collaborators, private sector actors, and academic institutions operating in Cislunar space.”

Our community should use this document as the opening to a larger and much longer conversation. It gives contexts to our discussions and informs us where our influence is being felt. Those of us within the LSIC who responded to the OSTP RFI and participated in discussions on these topics should take pride in having been a part of something historic, and look to where we can each help invent the future this landmark document motivates.

Member Spotlight

Vast Space, El Segundo, California

Mike Buckley, JHU/APL

The International Space Station might be slated for retirement in 2030, but the international space research community is working now on new ways for humans to access low-Earth orbit. One of those community members is Vast, a California-based startup developing commercial, artificial-gravity space stations. Vast, which joined the Lunar Surface Innovation Consortium in 2022, has a vision to enable large populations of humans to live and work in space without the harmful side effects of zero gravity. “We expect the Moon will be the proving ground for most, if not all, planetary surface habitation,” said Molly McCormick, a senior engineer at Vast, adding that the company will soon be in a position to facilitate many activities needed to support the next wave of lunar exploration. “With lunar-analog gravity environments, our space stations will be a unique platform for scientific research, technology demonstration, and operational training exercises,” she said. “This will be critical to ensure our first permanent steps off-planet are successful.”

Vast’s station modules are 7 meters (23 feet) in diameter – larger than the modules on the ISS – with gravity provided by rotating the entire structure. “At that scale, we can run human-subject lunar experiments,” said Colin Smith, a senior engineer at Vast. “Our first uncrewed test article will have partial-gravity payload capacity several orders of magnitude larger than what is currently available.”

Supporting Lunar Operations

As NASA and commercial space partners embark on the first missions to return to and remain on the Moon, testing in lunar analog environments is a critical step. Today, this happens in vacuum chambers on Earth with simulated lunar regolith – which, McCormick said, doesn’t accurately address the gravitational differences between Earth and space.

“We expect the Moon will be the proving ground for most, if not all, planetary surface habitation.”

Molly McCormick
Vast Senior Engineer

Vast looks to add this missing element by providing a spin-gravity capability in low-Earth orbit (LEO), working to ensure the physical side effects of that spin – the Coriolis effects – don’t overwhelm or invalidate the benefits of testing in reduced gravity. “In-space test operations have the added benefit of providing vacuum, as well as a pre-operational launch environment that mimics what the real lunar mission would experience and behind-the-console operational experience for users,” she said. “It’s effectively the closest match to the real thing, at a fraction of the cost and time.”

Vast has plans for several incremental test articles including an autonomous spinning subscale satellite and a crewed, single-module demonstration station. These provide early opportunities for lunar-analog testing, while Vast rigorously validates key technologies and operations necessary for larger scale stations.

Pursuing Partnerships

Krystle Caponio, chief legal officer at Vast, said the lunar science community is one of many the company intends to serve with its space stations. “We will be availing ourselves of upcoming launch technology that allows us to provide these facilities in-orbit at a large scale and at a commercially-viable price point,” she said. “Starting with our uncrewed test article, which is sized to launch on currently-operational launch vehicles, we will provide a lunar gravity LEO payload opportunity at an unprecedented size.”

NASA and Community News

NASA and DARPA to partner on nuclear thermal propulsion demonstration

Space News \ 24 January 2023 \ Jeff Foust

<https://spacenews.com/nasa-and-darpa-to-partner-on-nuclear-thermal-propulsion-demonstration/>

NASA Awards Students Flight Opportunity in TechRise Challenge

NASA \ 17 January 2023 \ Sarah Frazier \ Sarah Mann

<https://www.nasa.gov/press-release/nasa-awards-students-flight-opportunity-in-techrise-challenge/>

US, Japan Sign Space Collaboration Agreement at NASA Headquarters

NASA HQ \ 13 January 2023 \ Jackie McGuinness \ Cheryl Warner

<https://www.nasa.gov/press-release/us-japan-sign-space-collaboration-agreement-at-nasa-headquarters>

NASA Selects Experimental Space Technology Concepts for Initial Study

NASA \ 12 January 2023 \ Sarah Frazier

<https://www.nasa.gov/press-release/nasa-selects-experimental-space-technology-concepts-for-initial-study>

NASA Names New Agency-Wide Chief Technologist

NASA \ 09 January 2023 \ Rob Margetta

<https://www.nasa.gov/press-release/nasa-names-new-agency-wide-chief-technologist>

Funding Opportunities

Tech Development Opportunities

- [NSF SBIR and STTR](#)

The National Science Foundation recommends treating the submission window like a deadline, but you can submit anytime within a year of receiving an official invitation from NSF. NSF uses submission windows to help gather and review proposals, but proposals are sometimes reviewed as they are received.

Windows: Nov. 22, 2022 - March 1, 2023
March 2, 2023 - July 5, 2023
July 6, 2023 - Nov 1, 2023

- [NASA FY 2023 Phase I SBIR and STTR Solicitations](#)

The NASA Phase I SBIR and STTR solicitations are open to small businesses with 500 or fewer employees. To apply for an STTR, a small business must partner with a nonprofit research institution, such as a university or research laboratory. Phase I SBIR contracts last for six months, and Phase I STTR contracts last for 13 months, both with maximum funding of \$150,000. Anticipated release of the next Phase I SBIR/STTR solicitation will be in 2023.

Proposals Due: March 13, 2023

- [NASA Innovation Corps Pilot](#)

Proposals Due: Ongoing through March 29, 2023

- [Lunar Surface Technology Research \(LuSTR\) Opportunities](#)

Notice of Intention Due: March 22, 2023

Proposals Due: April 24, 2023

For more funding opportunities, please visit the [LSIC website](#)