Lunar Surface Innovation CONSORTIUM

LSIC Newsletter Volume 2 Issue 5 - May 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

We are really looking forward to getting together next week for the Spring Meeting! The overarching objective of this meeting is to update the community with NASA and LSIC's progress and plans (including funding opportunities) and to highlight recent technology developments in the community, network with one another, and gather feedback about how LSIC and NASA can invest in the development of critical technologies. For this meeting, we using two tools to aid our discussions and networking: Gather Town and our LSIC Confluence site. If you have not formally registered for the meeting and intend to join us for the poster session, coffee/networking sessions or the lunch networking session on Tuesday, which will feature several CLPS booths, you must be registered for the meeting. Your email address will be required in order to enter the Gather Town space. Confluence will be used for the breakout sessions, and while a moderator will share the Confluence page during the discussion, if you have a Confluence account you will be able to add comments and notes during (or after) the discussion. Please contact Andrea Harman (ams573@alumni.psu.edu) if you do not yet have a Confluence login and would like one.

The breakout sessions for the meeting include topics that have emerged from previous meetings. Part of the motivation for hosting the written discussion and notes in Confluence is that since these will be held in parallel, we would like to accommodate members who would like to follow and contribute to multiple topics. The breakout topics are: (1) Focus Group Goals and Cross-Group Integration; (2) Standardization; (3) Technology Readiness and Demonstrations; (4) Mentoring, Community Building, and Consortium Growth, and (5) Watts on the Moon Phase 2. More information on the objectives of each section is posted under the Spring Meeting Breakout Groups Confluence page (https://lsic-wiki.jhuapl.edu/x/gIbL). While most are broad, consortium-wide topics, the Watts on the Moon (WoTM) Phase 2 session will feature members of the WoTM Challenge team, and is an opportunity for those interested in power distribution and storage to speak directly with them about the rules for the second phase of this challenge. Note that a proposing team does not have to have won a WoTM Phase 1 to propose to the second phase of the challenge.

The Confluence meeting site will be updated throughout the week with posters, meeting links, and questions for the breakout groups and panels. If you have questions on your mind already that you would like the different panels to address, please feel welcome to post them in advance. We look forward to seeing you soon!

Rachel Klima
Director, Lunar Surface Innovation Consortium
SES-LSIC-Director@jhuapl.edu

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

LSIC Spring Meeting - 03 May Last Day To Register

Don't forget to sign up to participate in the upcoming LSIC Spring Meeting, to be held on 11-12 May 2021. The last day to register is 03 May. Sign up on the event website here: http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=124

KSC-20210429-PH-KLS02_0036
After completing its journey from NASA's Stennis Space Center in Mississippi aboard the Pegasus barge, teams with Exploration Ground Systems (EGS) and lead contractor Jacobs transport the massive Space Launch System (SLS) core stage to Kennedy Space Center's Vehicle Assembly Building in Florida on April 29, 2021.

Funding Opportunities

NLRA 2021-5: In-Space Production Applications: Advanced Manufacturing and Materials
https://www.issnationallab.org/research-on-the-iss/solicitations/nlra2021-5/
Step 1 Proposal Deadline: ***06 May 2021*** *- Step 2 Proposal Deadline:* ***22 June 2021***

Minority University Research and Education Project (MUREP) Space Technology Artemis Research (M-STAR) solicitation
https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7b417DB666-0D23-6D49-8BF4-F4EAF4B0AF5D%7d&path=&method=init
Proposal Submission Deadline: ***10 May 2021***

NASA-funded Scientific Payload for the Canadian Space Agency Lunar Exploration Accelerator Program (LEAP) Phase A Lunar Rover to be Delivered by CLPS
https://buyandsell.gc.ca/procurement-data/tender-notice/PW-ST-048-38561/list-of-interested-suppliers
List of Interested Suppliers Link Closes: ***May 20, 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: ***26 May 2021*** *- Proposal Due:* ***28 June 2021***

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

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 Lunar Challenge
https://breaktheicechallenge.com/
Phase 1 Registration and Submission Deadline: ***18 June 2021***

Funding opportunities regularly updated on the LSIC website here:
http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php

KSC-20210218-PH-GEB01_0010
The Space Launch System (SLS) rocket's interim cryogenic propulsion stage (ICPS) moved into the Multi-Payload Processing Facility February 18, 2021, at NASA's Kennedy Space Center in Florida for the Artemis I mission.

Feature Article: **Highlights From The Lunar Mapping For Precision Landing Workshop (March 2021)**

The Lunar Surface Innovation Consortium (LSIC) Workshop on Lunar Mapping for Precision Landing was held virtually March 2-4, 2021. The workshop included invited plenary speakers each day, breakout sessions to gather community input, and a poster session. The program and agenda were jointly planned with the LunaMaps team from NASA Space Technology Mission Directorate's Game Changing Development program. The three workshop days were broken into general themes: Day 1 focused on Terrain Relative Navigation (TRN) definitions and an introduction to Digital Elevation Maps (DEMs), Day 2 focused on DEM building and tools, and Day 3 focused on modeling and rendering the lunar surface. Community feedback was incredibly positive regarding the content included in the workshop and the amount of new information learned, and several new collaborations and conversations were identified as resultant from the workshop.

Recordings of the workshop and associated information can be accessed at the event website: http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=120

Goals

Precision landing and hazard avoidance systems are necessary to enable access across the lunar surface. Communication between lunar data providers and data users is necessary and, to date, has been inefficient. Thus, the high-level goal of the workshop was to bring together lunar geologists, data scientists, and navigation engineers that work on Terrain Relative Navigation (TRN) Systems for lunar missions to initiate new conversations about TRN for lunar missions, to provide participants with an overview of the available lunar orbital imagery data, a description of the lunar DEMs currently available, the considerations for using the data in the development and testing of TRN systems, and to collect community input about needs for developing robust TRN systems for lunar landed missions.

Attendance

Pre-registrations for the workshop included 425 attendees from over 138 institutions, including 12% non-profit, 19% academia, 34% industry, and 35% government. There were 288 attendees on day 1 of the meeting, 229 attendees on day 2 of the meeting, and 210 attendees on day 3 of the meeting.

High priority challenges and needs identified:

- Terrain Relative Navigation (TRN) systems need lunar maps with unique characteristics (e.g., format, resolution, metadata).
- Industrial partners and navigation engineers are not fully utilizing existing lunar data and more informational resources and conversations with mission teams may be needed to enable increased usage.
- Standard data sets and controlled maps would be beneficial for testing algorithms.
- Current flight-qualified processor capability may be insufficient for advanced TRN algorithms and map processing.
- Targeted new missions and instrumentation would fill gaps in data needed for TRN systems.
- Standardized rendering tools, data verification and validations metrics, and metadata are desired by the community.

Member Spotlight: **Paul van Susante, Michigan Tech**

Dr. Paul van Susante, an active member of the LSIC community, works as an assistant professor of mechanical engineering at Michigan Technological University. His focus sees him working as a Mining Innovation Enterprise (MINE) faculty advisor and as PI of Planetary Surface Technology Development Lab (PSTDL). After 7 years as a lecturer, Dr. van Susante decided to focus more on research to help pave the way for a return to the Moon, culminating most recently in his work with PSTDL to rapidly develop and test surface technology for use on extraterrestrial planetary surfaces. He recently guided a student team to win NASA's Big Idea Challenge, and also received a LuSTR award. The PSTDL and other testing facilities at Michigan Tech were vital to securing both of those wins.

"One of the reasons why I founded this lab [PSTDL] was because I saw there was a big need for the capability to do that testing – being able to test in a relevant environment to go from TRL 1 to TRL 6," stated Dr. van Susante. The lab started with a low TRL basic sandbox, then moved on to a regolith sandbox in standard atmospheric conditions. With obstacle and slope testing up to 45 degrees possible, it also has a gravity offloading system to simulate lunar as well as Martian gravity. Work continues to include active vertical z axis and gimbal control. Next, a dusty thermal vacuum chamber was installed and is now fully operational. Within the chamber's thermal shroud the usable space is 1.2 meters wide by 1.3 meters tall by 1.7 meters long, and can be cooled to -196 F or heated to 150 F.

The Big Idea Challenge

The Planetary Surface Technology Development Lab (PSTDL) was critical to the success of Dr. van Susante's student team. The challenge's objective was to propose and develop test technologies to help NASA explore and operate in permanently shadowed regions (PSRs) on the Moon. The students built and tested a vehicle that deploys a superconducting power cable or tether between a CLPS lander on a crater's rim down into a PSR. "We were trying to use the environment to our advantage," Dr. van Susante explained. The lunar surface is insulating both thermally and electrically, allowing less insulation (and therefore less mass) for cables. The tether's 2 kilometer spool ended up weighing just over 2 kilograms, with the entire system coming in at less than 30 kilograms.

The students iterated through designs, testing first in the PSTDL's sandboxes for slope and obstacles,

Dr. Paul van Susante (fourth from left, blue shirt) pictured with student members of the winning Big Idea Challenge team.

then moving on to the dusty thermal vacuum chamber to finally prove the system's capabilities in a relevant environment, and winning the challenge. If you want to transfer 10 kilowatts of power, the deployed tether could deliver almost 94% to the end point. "We can do communication and power over those lines, so we basically created the most popular place in the PSR with both Wi-Fi and a place to charge your phone," laughed Dr van Susante.

Lunar Surface Technology Research (LuSTR) Award

Pursuing the LuSTR award had Dr. van Susante utilizing another testing facility at Michigan Tech, the Keweenaw Research Center. Boasting 900 acres of test terrain for vehicles, the challenging Michigan winters and the facilities at Keweenaw often bring major car manufacturers to test their vehicles for safety. The track is fully digitized, allowing predicted performance to be measured against actual performance easily. Some of the funds from the LuSTR award will go towards creating a large trench, filled with lunar simulant, and some freezing Michigan winter weather allowing measurement of ice content (among other things) with the percussive heated cone penetrometer and ground penetrating radar.

"I've been saying for a while now that being able to identify and quantify volatile composition, as well as variability in x, y, and z dimensions below the lunar surface is a big thing we don't know right now." Dr. van Susante proposed a combination of percussive heated cone penetrometer and ground penetrating radar (GPR) to determine, based on the heating profile generated, not only what volatiles are present, but how much of them there is. "It's called differential scanning calorimetry (DSC)," expounded Dr. van Susante, and will require both a percussive heated cone penetrometer and a modified Z-stage of Honeybee's Trident drill. A data set will be created to show profiles for different volatiles expected on the lunar surface, and test beds will be set up with known quantities. "We're developing the algorithm to see what's down there," said van Susante. "If I measure some volatiles here and don't measure for another 100 feet, we don't know what happens in between. But the GPR can tell us continuity of layers in between – if there's a clear ice layer, GPR can say if it's continuous or patchy."

A Winning Strategy

With two prestigious (and wildly different) awards under his belt, we asked Dr. van Susante if he had any keys to success to share. "I think one of the key items is to really understand what the RFP is asking for," he responded. "It's not pushing your idea – you have to take the ego out of it. It's trying to figure out what they want you to develop, and what you propose has to check those boxes." He further stressed the importance of a good plan, including the required resources, facilities, and team, needed to deliver what a proposal promises. "That's always challenging with new technologies," Dr van Susante continued, "which is why I founded the PSTDL." He gave the example of the superconducting tether from the BIG Idea Challenge. "It's not a new idea – it's part of my master's thesis from 2001. But you have to take the opportunity to further explore and test." Another key factor to success he identified is framing your idea in the bigger picture of an overall program. According to Dr. Van Susante, "Whatever you propose, it has to fit in the bigger picture – that's the key."

To find out more about Dr. van Susante's work, or the testing facilities offered at Michigan, you can reach him at pjvansus@mtu.edu.

Community Bulletin Board

Input Requested From Terrain Relative Navigation Subject Matter Experts
Submitted by Chelsea McMahon, Open Lunar Foundation
Chelsea McMahon, a technical research fellow at the Open Lunar Foundation, is seeking input from experts on Terrain Relative Navigation (TRN) to determine if there is value in creating standards for optical navigation.

The focus is on understanding the biggest hurdles currently faced in TRN, and if/where there is a solution for those hurdles via open-source tools or collaboration between CLPS agents. She is conducting brief interviews to inform a report on the utility of transparent innovation within lunar landing technology. Please reach out if interested in participating, or if you have a suggestion for someone who would like to comment: c.mcmahon.fellowship@openlunar.org

NASA News

Biden-Harris Administration Shows Strong Support for NASA in First 100 Days
29 April 2021 (RELEASE 21-050): In the first 100 days of the Biden-Harris Administration, NASA has taken bold steps to expand America's exploration and scientific frontiers, advancing the nation's commitment to build back better through innovation, combat climate change, re-establish America's standing abroad, and inspire the next generation. "In just the first 100 days of their administration, President Biden and Vice President Harris have expressed strong support for NASA's goals and missions – and have laid out a vision that will guide the agency for the years to come," said acting NASA Chief of Staff Bhavya Lal, the senior-most political appointee at the agency. "The president's discretionary budget, engagement with the NASA workforce, and appointment of a White House senior climate advisor underscore the president's strong support for the agency's awe-inspiring missions and incredible science that informs critical policymaking decisions. NASA has a vibrant future ahead under the Biden-Harris Administration." Click here to read more.

MAF_20210429_CS2_LH2toVAB579: This image highlights the liquid hydrogen tank that will be used on the core stage of NASA's Space Launch System rocket for Artemis II, the first crewed mission of NASA's Artemis program. The tank is being built at NASA's Michoud Assembly Facility in New Orleans.

NASA, NSF Join Forces to Bolster Student Diversity in Engineering

26 April 2021 (RELEASE 21-043): NASA and the U.S. National Science Foundation (NSF) have signed a memorandum of understanding to collaborate on an initiative to open new avenues to engineering careers for communities underserved and underrepresented in STEM, through Minority-Serving Institutions (MSIs). Engineers are essential to America's goals to send humans back to the Moon and, eventually, on to Mars. Successful innovation depends on an array of ideas and skillsets to further discoveries in the fields of science, technology, engineering, and mathematics. Through this new initiative, called "Building MSI-Led Coalitions to Strengthen Broadening Participation in Engineering," NASA and NSF will develop engagement activities benefiting both agencies and create funding opportunities for institutions and organizations to plan and build coalitions with the specific focus on diversifying the engineering workforce. Click here to read more.

Illustration of SpaceX Starship human lander design that will carry the first NASA astronauts to the surface of the Moon under the Artemis program. Credits: SpaceX

As Artemis Moves Forward, NASA Picks SpaceX to Land Next Americans on Moon

16 April 2021 (RELEASE 21-042): NASA is getting ready to send astronauts to explore more of the Moon as part of the Artemis program, and the agency has selected SpaceX to continue development of the first commercial human lander that will safely carry the next two American astronauts to the lunar surface. At least one of those astronauts will make history as the first woman on the Moon. Another goal of the Artemis program includes landing the first person of color on the lunar surface. Click here to read more.

NASA Selects Innovative, Early-Stage Tech Concepts for Continued Study

08 April 2021 (RELEASE 21-037): NASA encourages researchers to develop and study unexpected approaches for traveling through, understanding, and exploring space. To further these goals, the agency has selected seven studies for additional funding – totaling $5 million – from the NASA Innovative Advanced Concepts (NIAC) program. The researchers previously received at least one NIAC award related to their proposals. Click here to read more.