



# Lunar Surface Innovation

C O N S O R T I U M

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## Extreme Access Focus Group Telecon

February 11, 2021

We'll start around 3:03

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# Today's Agenda

- Upcoming Meetings/Opportunities
- LSIC Updates
- Feedback on Dust Mitigation Workshop
- Subgroup introduction: Lunar sheds/Wadis
- Getting to know the community
- Annual Goal Discussion
- Open floor and Discussion

# Upcoming Meetings

- Focus Group Telecons (2<sup>nd</sup> Thursday each month, 3-4 pm EST)
  - February 11, 2021
  - March 11, 2021
- Lunar Surface Science Workshop
  - Structuring Real-Time Science Support of Artemis Crewed Operations, February 24-25, 2021
  - Free, but **registration is required**
  - <https://www.hou.usra.edu/meetings/lunarsurface2020/>
- LSIC EA Workshop: Workshop on Lunar Mapping for Precision Landing
  - <http://lsic.jhuapl.edu/Events/Agenda/index.php?id=120>
  - Registration and abstract submission now open!
  - March 2-4, 2021, 12-4 pm ET

# Workshop on Lunar Mapping for Precision Landing

- March 2-4, 2021
  - 12-4 ET each day
  - <http://lsic.jhuapl.edu/Events/Agenda/index.php?id=120>
- Goal: Bring together lunar geologists, data scientists, navigation engineers
- Objective: Develop a mutual understanding of map requirements to achieve lunar TRN solutions and provide better insight into the map data and map building processes
- We are seeking input from the community to help NASA catalog existing tools, methods and approaches for building DEMS, accurate rendering of the surface, V&V of TRN systems

# Workshop on Lunar Mapping for Precision Landing

- The workshop will include a mixture of invited presentations, panel discussions, and breakout discussions.
- Day 1 will cover TRN and Digital Elevation Map Basics, including an overview of currently available data, best practices, and overviews of TRN systems in use on OSIRIS-REx and Mars 2020.
- Day 2 will be focused on DEM building methods and tools
- Day 3 will focus on modeling lunar surface features and terrain rendering tools, including a poster session focused on descriptions of current terrain rendering tools. If you would like to present at the poster session, please submit an abstract by February 16. Details are available on the website.
- Abstracts due February 16 to present a poster
- Registration Closes February 26.

- Current Funding Opportunities:
  - 2021 NIAC Phase II and III solicitation, proposals due February 17, 2021
  - 2021 Early Career Faculty appendix: NOI February 24, proposals due March 24, 2021
  - NASA SBIR Phase II Solicitation, due March 1, 2021
  
  - Watts on the Moon Centennial Challenge
    - <https://www.herox.com/WattsOnTheMoon>
    - Phase 1 Registration and Submission Deadline: 25 March 2021
  
  - Break the Ice Lunar Challenge
    - <https://breaktheicechallenge.com/>
    - Registration and System Architecture Submission Deadline: 18 June 2021
  
  - <http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php>

# Break the Ice Lunar Challenge (NASA Centennial Challenge)

***Excavate icy regolith and deliver acquired resources in extreme lunar conditions***

<https://breaktheicechallenge.com/>

**Webinar on Thursday, February 25, 2021 at 11:00 am – 12:00 pm CST** to learn about this challenge and the latest technologies for excavation in extreme environments on the Moon and Earth.

Registration link : [https://zoom.us/webinar/register/WN\\_oyXzvaPcRLeXSTCRe66QaA](https://zoom.us/webinar/register/WN_oyXzvaPcRLeXSTCRe66QaA)

At the webinar, you'll hear from:

- Monsi Roman, Program Manager, NASA Centennial Challenges Program
- Don Thomas, Former NASA Astronaut
- Pete Carrato, Fellow Emeritus, Bechtel Corporation
- Kris Zacny, VP & Director, Exploration Technology, Honeybee Robotics
- Judson Kauffman, Co-CEO, Terradepth

# Extreme Environments – Feb 21

*Currently kicking off an activity: Identifying and Classifying Specific Challenging Lunar Environments*

- What are specific lunar environment (or sites) that present significant technical challenges to survive and operate on the lunar surface or subsurface?
  - LSIC-EE has five active subgroups focused on different aspects of the lunar environment that will evaluate each nominated environment / site
    - Lots of information on Confluence! <https://lsic-wiki.jhuapl.edu/display/EE/>
- How do specific lunar environment differ from descriptions of the general lunar environment?
  - Compare to NASA Cross-Program Design Specification for Natural Environments (DSNE) Revision H
    - <https://ntrs.nasa.gov/citations/20205007447>
- Suggest environments or sites via 1 minute survey here: [http://bit.ly/LSIC\\_Env\\_Survey](http://bit.ly/LSIC_Env_Survey)

*LSIC-EE Focus Group Meets 2<sup>nd</sup> Tuesday of the month at 3:05 pm*



# Surface Power Recent Activities

- Telecons: Fourth Thursday of the month, 11:00 am ET
- Funding opportunities:
  - Watts on the Moon (focused on power distribution)
  - Anticipated DoE calls on nuclear power
- Subgroups:
  - Generation (including specific interests in nuclear generation and fuel cells)
  - PMAD (Power management and Distribution)
- New NASA POC John Scott
- Annual goal:
  - **“Provide specific recommendations and a staged road map to NASA for rapidly achieving appropriate-scale power-related technologies needed to enable sustained presence and exploration, in the context of a polar lunar outpost.**
  - Initial focus on understanding the “appropriate scale” of power over time
    - Next steps could be power-scaling study/workshop, extension of the ISRU supply & demand workshop results to power, etc.



# ISRU FG Jan 20 Monthly Meeting Summary

- The “ISRU Library and Resources” page on Confluence ISRU section is active and being populated with resources. We post ISRU tech resources you want to provide to the community, including NASA reports, .pptx presentations, as well as links to peer-reviewed literature.
- 
- Lunar Trailblazer mission from an ISRU perspective - Dr. Bethany Ehlmann
  - The Trailblazer observations and how they can potentially inform on the abundance and distribution of ice in PSRs.
  - Discussions can be followed on Confluence in the ISRU pages under [“ISRU Conversations/Trailblazer”](#)
- 
- ISRU Technology Considerations for Preserving the Lunar Environment – Dr. Parvathy Prem
  - Planetary protection, in terms of protecting/preserving the pristine lunar environment from the effects of human activity.
  - We are just beginning this conversation. Definitions and requirements are needed. Concerns need to be quantified as well as understanding scale of effects due to human activities. This may impact how to optimize technology for operation on the Moon.
  - Discussions can be followed on Confluence in the ISRU pages under [“ISRU Conversations/ISRU Technology Perspective on Impacting the Lunar Environment”](#)

# Dust Mitigation Focus Group

Contact: [Facilitator\\_DustMitigation@jhuapl.edu](mailto:Facilitator_DustMitigation@jhuapl.edu)

- **Workshop Objectives:**

- Bring together key stake holders:
  - Government, Industry, Academia, and Non-profit
  - Architecture developers, dust mitigation technology developers, scientists, and others interested in dust mitigation
- Identify what technologies are already available
- Identify what are the current challenges and gaps in Dust Mitigation
- Identify areas in need of investment and future opportunities

- **Format:**

- Invited presentations from NASA, academia, and industry (9)
- Contributed lightning talks from NASA, academia, industry, and non-profit (19)
- Breakout discussion sessions (5)

- **Breakout Session Focus Areas:**

- Ascent/Descent, Dust Plumes, and Surface Modification
- EVA, Spacesuits, and Habitats
- Surface Mobility and Operations
- Instruments, Tools, and Mechanisms
- ISRU and Surface Power

## LSIC Dust Mitigation Workshop



[LSIC Dust Mitigation Workshop Website](#)

- Held Thursday, February 4th
- Over 340 attendees across US
- Over 140 participants in breakout discussion groups
- Presentations and recordings will be posted on workshop website

# Join the Discussion on Confluence

The screenshot shows a Confluence page titled "11 February 2021" under the "Extreme Access" space. The page content includes a breadcrumb trail, a title, creation info, a call to action for comments, a list of discussion topics, a "Please add comments below" section with bullet points, a "Like" button, a comment input field, and a disclaimer at the bottom. To the right of the page content, there is a numbered list of three instructions.

Dashboard / Extreme Access Home / EA Monthly Meeting

## 11 February 2021

Created by Angela Stickle, last modified just a moment ago

Add a comment to sign in below and click on a discussion topic to contribute your thoughts!

- Subgroup Announcement: Lunar Sheds
- Annual Goal Discussion

Please add comments below for general discussion, including:

- Feedback about Dust Mitigation Workshop
- Who's Who format

Like Be the first to like this

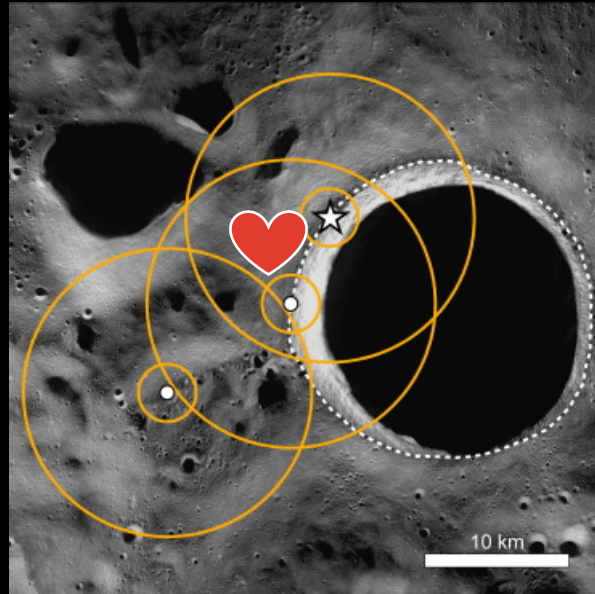
Write a comment...

Content posted to LSIC must be approved for public release. Remember to safeguard your intellectual property when sharing information, as this forum is open to all the members of the consortium. Please read the code of conduct (available on homepage) in mind when posting.

1. Add a comment to sign in
2. Select an agenda topic and comment your thoughts
3. Follow-up after the telecon to continue to discussion!

# Subgroup Introduction

- Lunar sheds/wadis
- Lead: Chuck Lauer



## • **Multi-user Full Service Business Model**

- Drive down lunar surface O&M cost by sharing resources
- Commercially developed and operated
- Incremental growth in capabilities as user base expands
- Government(s?) anchor tenancy to help close business case
- Able to support both robotic and human surface operations
- Customer requirements drive design and phasing plans
- Eventual support hub for lunar tourism and commercial mining
- Governance system developed using Artemis Accords

## • **Notional Functional Requirements**

- Power generation and distribution into PSR sub-hubs
- Thermal shelter against lunar night conditions
- Hydrogen and Oxygen production and storage for customer distribution – both gaseous and cryo supplies
- Dust cleaning services
- Routine maintenance & repair services including parts depot
- Eventual Crew / Tourism Accommodations

## • **Next Steps**

- Develop user / stakeholder community
- Develop requirements / desirements documents
- Inventory components and systems currently in design / development phase
- Identify critical technology gaps and TRL raising activities
- Define Minimum Viable Product (MVP)
- Create phased Business Plan and Development Plan

# Get to know the community

LSIC Spaces People Create ... Search ?

Extreme Access

Pages

Blog

PAGE TREE

- > EA Conversations
- > EA Monthly Meeting
- > Subgroup Discussion Space
- **Who's Who in EA**

Dashboard / Extreme Access Home

Edit Save for later Watching Share ...

## Who's Who in EA

Created by Andrea Harman, last modified by Angela Stickle just a moment ago

Click the "Edit" button in the upper right-hand corner to add your details to the table below.

Who You Are	What You Do	What You Want Others To Know About You	Other Comments	Website, Contact Info, POC
Angela Stickle	LSIC EA Focus Group Facilitator : I help facilitate conversations between NASA, industry, academia, non-profits, and other government agencies.	I'm here to help you get exposure, get your ideas out there, talk to NASA, and to know what NASA is doing and how it affects your technology projects.		<a href="mailto:Angela.Stickle@jhuapl.edu">Angela.Stickle@jhuapl.edu</a> <a href="mailto:Facilitator_ExtremeAccess@jhuapl.edu">Facilitator_ExtremeAccess@jhuapl.edu</a> <a href="http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php">http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php</a>

Like Be the first to like this

No labels

<https://lsic-wiki.jhuapl.edu/display/EA/Who%27s+Who+in+EA>

# LSIC EA Annual Goal

- Collaboratively decide on a 1-year goal for us to work on as a group
  - Actionable
  - Impactful
  - Relevant to focus area
  - Doable within 1 year
  - Uses capabilities of focus group members
  - Can be accomplished with existing resources
  - Inspired by current issues
  - Beneficial broadly to all stakeholders
- Won't be the only thing we work on! But it can be a focus/consensus need.



# LSIC EA Annual Goal

- Build a community and develop collaborative relationships among members
- Identify specific areas of interest on the Moon that require extreme access (e.g, lunar south pole, PSRs, lunar pits)
- For 1-2 areas of interest we will identify mission/system architecture elements needed to provide access (e.g., mobility challenges, comms, PNT, etc), including identifying specific technology needs and gaps, prioritizing development timelines, and providing a general roadmap and recommendations for needed technology, testing, and demonstrations.

# How? Let's discuss tasks!

1. Identify areas and/or environments of interest
2. Pick 1-2
3. Identify specific architectures to enable exploration of these areas. What are the environments like? What are the needs for mobility, PNT, comms, autonomy?
4. Evaluate current technology availability, compare to what is needed for (3). This will likely involve standing up several smaller subgroups.
5. Identify gaps, prioritize which are more important to close first
6. Roadmap, determine recommendations for specific tech development and/or demos
7. Throughout: keep in mind where will need input or tech crossover from other focus groups. Where does technology development require multiple inputs?
8. Write a report of some sort



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APPLIED PHYSICS LABORATORY

- Confluence is our record of discussions and a good repository
  - Confluence is free to you and available to all registered LSIC members
  - We will be using Confluence to document discussions and provide resources to LSIC members. All focus groups have a separate page so it's a good collaboration space.
  - To request an account, please email Andrea Harman: [ams573@alumni.psu.edu](mailto:ams573@alumni.psu.edu)
- Technology Spotlights/Lightning Talks at monthly telecons
  - Anyone can volunteer to give a lightning talk (10-20 mins)
  - Email Angela or Sarah, or comment on Confluence, to sign up!
- Updates to the webpage - <http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php>
  - Notes, slides, recordings from telecons posted here

Follow the Code of Conduct for all Focus Group communications

# Contact information

LSIC Director: Rachel Klima, [SES-LSIC-Director@jhuapl.edu](mailto:SES-LSIC-Director@jhuapl.edu)  
<http://lsic.jhuapl.edu>

Focus Group Area	Listserv address	Facilitator
In-Situ Resource Utilization	<a href="mailto:LSIC_ISRU@listserv.jhuapl.edu">LSIC_ISRU@listserv.jhuapl.edu</a>	Karl Hibbitts
Surface Power	<a href="mailto:LSIC_Power@listserv.jhuapl.edu">LSIC_Power@listserv.jhuapl.edu</a>	Wes Fuhrman
Extreme Environments	<a href="mailto:LSIC_ExtremeEnvironment@listserv.jhuapl.edu">LSIC_ExtremeEnvironment@listserv.jhuapl.edu</a>	Ben Greenhagen
Extreme Access	<a href="mailto:LSIC_ExtremeAccess@listserv.jhuapl.edu">LSIC_ExtremeAccess@listserv.jhuapl.edu</a>	Angela Stickle
Excavation and Construction	<a href="mailto:LSIC_ExcavationConstruction@listserv.jhuapl.edu">LSIC_ExcavationConstruction@listserv.jhuapl.edu</a>	Athonu Chatterjee
Dust Mitigation	<a href="mailto:LSIC_DustMitigation@listserv.jhuapl.edu">LSIC_DustMitigation@listserv.jhuapl.edu</a>	Jorge Núñez

# STMD Opportunities for Academia and Industry

STMD anticipates awarding ~\$600M to academia and industry supporting 2020 solicitations & awards

STMD Tipping Point Multiple Awards: *Jan – Mar 2020*

\$250M

Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Phases I, II, II-E, Civilian Commercialization Readiness Pilot Program (CCRPP), Sequential: *Phase I Solicitation Jan – Apr 2020*

\$212M

Announcement of Collaborative Opportunity (ACO): *Jan – Mar 2020*

\$10M

Flight Opportunities Tech Flights: *Feb – May 2020*

\$10M

Early Career Faculty (ECF): *Feb – Apr 2020*

\$6M

Early Stage Innovations (ESI): *Apr – Jun 2020*

\$9M

NASA Innovative Advanced Concepts (NIAC) Phases I, II, III: *Phase I Solicitation Jun – Jul 2020*

\$4M

Space Technology Research Institutes (STRI): *Jun – Aug 2020*

\$30M

NASA Space Technology Graduate Research Opportunities (NSTGRO): *Sep – Nov 2020*

\$19M

SmallSat Technology Partnerships (STP): *Sep – Nov 2021*

\$3M

Centennial Challenges: *Varied release dates*

\$8M

NextSTEP Broad Agency Announcements (BAAs): *Varied release dates*

Varies

Lunar Surface Technology Research (LuSTR) Opportunities: *Coming soon!!!*

\$30M

Note: Funding awards are approximate and subject to change

Open Solicitations as of June 5, 2020

Solicitations were/will be open in the timeframe specified in italics