



Lunar Surface Innovation

C O N S O R T I U M

LSIC Excavation and Construction Focus Group

<http://lsic.jhuapl.edu/>

August 28, 2020

Athonu Chatterjee

Athonu.Chatterjee@jhuapl.edu



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Friendly Reminders

- Slides, chat and recording will be posted in our website in 2-3 days.
(<http://lsic.jhuapl.edu/Focus-Areas/Excavation-and-Construction.php>)
- Feel free to post your questions/suggestions in ‘chat’.
 - We can get back to you later, if not now.
- Please mute yourself if you are not speaking.

Agenda

- LSIC announcements
 - LSIC Fall symposium (October 14 and 15).
 - ISRU workshop – supply and demand (September 17)
 - Communication updates – Confluence is here.
- Two presentations:
 - (1) Jim Keravala , “Autonomous Vehicles and Robots for E&C”.

Jim is the cofounder and CEO of **OffWorld**, a CA-based company that is developing new generation of universal industrial robots to do the heavy lifting on Earth, Moon, asteroids and Mars.

(2) Dr. Jennifer Edmunson - “Challenges and Benefits of Excavation and Construction on the Moon”.

Jennifer is part of the Space Technology Development Branch at **Marshall Space Flight Center**, and is currently working on the Moon to Mars Planetary Autonomous Construction Technology Project. She has her doctorate in Earth and Planetary Sciences, and uses her knowledge of lunar and martian geology in ISRU technology development and regolith simulants.

LSIC Objectives

1. Harness the creativity, energy and resources of academia, industry, non-profits and government in order for NASA to keep the United States at the forefront of lunar exploration
2. Identify lunar surface technology developments most in need of sponsor support and communicate those to NASA
3. Provide a central resource for gathering and disseminating information, results, and documentation

Please contact me if you want to present at this forum.



Fall LSIC workshop (October 14-15)

- Virtually hosted by ASU in collaboration with APL.
- Technical focus on the interrelationships between the six LSIC focus areas in the context of surface power.
- Feature keynote addresses, working sessions, and technical poster presentations.
- Abstracts for posters are being accepted through Sept. 11.
- <http://lsic.jhuapl.edu/Events/> for more information.

ISRU Supply & Demand Workshop

- Objective: bring potential ISRU consumers and producers together to discuss ISRU supply and demand issues.
 - September 17, 12 PM – 5 PM, EST.
 - No registration required for LSIC members.
- Format:
 - 5-10 minutes per talk.
 - Focused on quantities.
 - Two sessions: supply and demand, with questions/networking sessions in between.
- <http://lsic.jhuapl.edu/Events/103.php?id=103>

Communication

- Confluence is up and running – 2000 licenses available.
- <http://lsic-wiki.jhuapl.edu/> (sign-up required)
- Confluence will be used to enable more rapid communications, break out discussions, and as a repository of information.
- Andrea Harman is the LSIC Confluence Facilitator.
 - Contact Andrea for access: ams573@alumni.psu.edu
 - Training sessions available.

Today's Talks

(1) Jim Keravala , “Autonomous Vehicles and Robots for E&C”.

(2) Dr. Jennifer Edmunson - “Challenges and Benefits of Excavation and Construction on the Moon”.



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Excavation and Construction Focus Group



Supporting STMD in developing technologies that enable affordable, autonomous manufacturing or construction for sustained human presence.

The goal(s) of the LSIC Excavation and Construction focus group is to assess technologies related to lightweight manufacturing, mining, and assembly equipment that can process in-situ lunar surface materials. Relevant manufacturing and assembly processes will be assessed some of which are additive construction, deployable metal structures, sintering, molten regolith fiber pulling, etc.

APL Facilitator: Athonu Chatterjee – Athonu.Chatterjee@jhuapl.edu

NASA Lead: John Vickers – john.h.vickers@nasa.gov

(NASA principal technologist in the area of advanced manufacturing. Associate Director of the Materials and Processes Laboratory at NASA's Marshall Space Flight Center. Manager of the NASA National Center for Advanced Manufacturing)

Website: <http://lsic.jhuapl.edu/Focus-Areas/Excavation-and-Construction.php>

Mailing List: LSIC_ExcavationConstruction@listserv.jhuapl.edu

Membership: 210 members

• **Zoom Meeting:** <https://jhuapl.zoomgov.com/j/1605411480?pwd=a3BBR2hNSG41OUhiRyt2V3R2MXNldz09>

Focus Group Composition

Academia : 37%

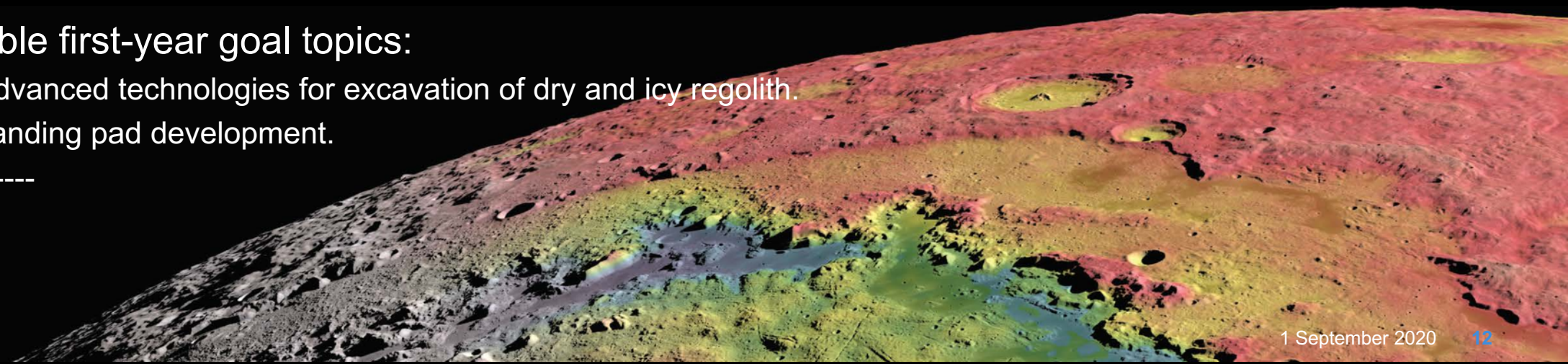
Government : 21%

Industry : 41%

Habitat construction in lunar conditions. (Inflatable habitat, underground habitat, radiation shielding, multi-functional materials/structures)	70.5%
Manufacturing processes for lunar construction. (Additive manufacturing, sintering, regolith fiber pulling)	63.6%
Excavation technology for hard regolith/icy material. (Drilling, mining, lightweight construction equipment)	61.4%
Autonomous vehicles and robots for E&C on lunar surface.	59.1%
Lunar surface structure development. (Landing pads, berms, roads)	54.5%
Increased autonomy of operations.	34.1%
Virtual lunar terrain simulation.	29.5%
Beyond additive technology.	22.7%
Long duration robust , easily maintainable robot design for industrial scale use (not science)	2.3%
Subsurface and interior imaging and composition analysis	2.3%
Compressed, sifted regolith as a building material	2.3%
Spacecraft refueling station development	2.3%

Focus Group Goal

- The E&C FG is tasked to define a 1 year goal.
- Will collaboratively decide on a 1-year goal for us to work on as a group based on technology areas survey and NASA priorities.
- Goal needs to be
 - Actionable
 - Impactful
 - Address clear need of NASA
 - Can be accomplished with existing resources
 - Inspired by current issues
 - Beneficial broadly to all stakeholders
- Possible first-year goal topics:
 - Advanced technologies for excavation of dry and icy regolith.
 - Landing pad development.
 - -----



Specific Goals

- Identify technology needs
- Serve without bias
- Develop talent
- Build community
- Serve as an information clearinghouse
- Host regular cross-community meetings
- Lead and coordinate focus groups
- Enable site visits from LSIC and LSII leadership
- Establish mentoring relationships among members

Focus Groups are the primary means through which LSIC interacts with the community.

LSII System Integrator - APL

A key tenet of LSII is to implement a multitude of novel collaborations across industry, academia, and government in order to successfully develop the transformative capabilities for lunar surface exploration.

Origin of the APL Task

- NASA was investigating using a University Affiliated Research Center (UARC) to bring efficiencies to development
- LSII initiated a tasked APL, to assess system integration role for the Lunar Surface Innovation Initiative
- APL established a Lunar Surface Consortium with academia and industry representatives, as well as NASA experts, that span a broad range of capabilities to execute timely studies, tasks, and/or acquisitions

The Consortium will assist NASA in

- Identifying lunar surface technology needs and assessing the readiness of relative systems and components
- Making recommendations for a cohesive, executable strategy for development and deployment of the technologies required for successful lunar surface exploration
- Providing a central resource for gathering information, analytical integration of lunar surface technology demonstration interfaces, and sharing of results

