Lunar Surface Innovation Initiative
Excavation and Construction

FALL MEETING OF THE AERONAUTICS AND SPACE ENGINEERING BOARD
The National Academies of Sciences, Engineering, and Medicine

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Lunar Surface Innovation Initiative (LSII)

NASA’s LSII works across industry, academia and government through in-house efforts and public-private partnerships to develop transformative capabilities for lunar surface exploration.

- Formulating and integrating technology maturation activities across the TRL pipeline and Space Tech programs
- Leveraging innovative collaborations and partnerships to expedite technology development
- Utilizing early uncrewed lunar surface flight opportunities to inform key technology development
- Johns Hopkins Applied Physics Lab (APL) is the LSII integrator for NASA, including establishing the new Lunar Surface Innovation Consortium (LSIC).
SpaceTech matures key technologies in order for the primary technology hurdles to be retired for a given capability at a relevant scale.
LSII | Rapid Technology Development

2019 → onward
Technology maturation

2021 → onward
Flight demonstrations & pilot programs

2028 → onward
Sustained lunar presence

LSII provides the early technology development to enable a sustainable lunar presence.
LSII Technology Demonstration Planning

LSII leverages early lunar missions to accelerate development of core surface technologies

**2020**

- **ISRU**
  - Volatiles Investigating Polar Exploration Rover (VIPER/SMD)
  - ISRU Ice-Mining Demo
  - ISRU Oxygen Extraction Demo

- **Surface Power**
  - ISRU Ice-Mining Experiment (PRIME)
  - Regenerative Fuel Cell Power
  - Chemical Heat Integrated Power Source (CHIPS)
  - Wireless Charging for Lunar Surface Demo
  - Vertical Solar Array Technology (VSAT)

- **Dust Mitigation**
  - Electrodynamic Dust Shield
  - Lunar Dust Level Sensor & Affects on Radiators
  - Lunar Dust Smart Sensor for Crewed Environments
  - Lunar Dust Removal Tool

- **Extreme Environments**
  - Lunar Arm w/ Bulk Metallic Glass Gears
  - Lunar Materials Demo
  - Lunar Camera
  - Lunar Thermal Toolbox

- **Extreme Access**
  - Tipping Point Early Hopper CLPS Opportunity
  - Deployable Hopper
  - Autonomous Robotics
  - Day/Night Lunar Rover Obstacle Avoidance
  - Autonomous Exploration of Lunar Pits

- **Excavation & Construction**
  - ISRU Pilot Excavator
  - Lunar Surface Construction Demo 1
  - Lunar Surface Construction Demo (Landing Pad)

**2030**

- **ISRU Pilot Plant**
- **Fission Surface Power Demo**

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Lunar Surface Innovation Consortium (LSIC)

The Consortium is a nationwide alliance of academia, industry, non-profits and other government agencies with a vested interest in establishing a sustained presence on the Moon.

LSIC has over 1,000 participants from over 300 organizations across the U.S.

Consortium Objectives:

- Identify lunar surface technology needs
- Make recommendations for addressing key lunar surface gaps
- Provide a central resource for gathering information and sharing of results

Focus Group Objectives:

- Establish collaborative relationships among members
- Build community and develop talent
- Compile member input and report outcomes and recommendations

Bi-annual meetings, with monthly virtual Focus Group for regular interaction.

Please visit lsic.jhuapl.edu for additional information on the Consortium.
Excavation and Construction Focus Group

Assist NASA in developing technologies that enable affordable, robust, autonomous, construction of infrastructure on the lunar surface to establish a sustained human presence

Meetings: 4th Wednesday of the Month 2 – 3 PM Eastern
Mailing List: LSIC_ExcavationConstruction@listserv.jhuapl.edu
Website: http://lsic.jhuapl.edu/Focus-Areas/Excavation-and-Construction.php
Excavation & Construction Wiki: https://lsic-wiki.jhuapl.edu/display/EC
To Join E&C FG contact athonu.Chatterjee@jhuapl.edu

FG Activities:
- Monthly telecons
- Periodic workshops
E &C Technical Focus Areas

• Infrastructure:
  - Landing and Launch Pads
  - Habitats: surface and underground
  - Roads, Berms, etc.

• Technology:
  - Additive Construction
  - Autonomous Construction
  - Excavation tools for lunar applications
  - Manufacturing technologies: sintering, regolith processing, additive manufacturing

• In-situ Repair and Outfitting
  - Maintaining the infrastructure
    • Spare parts
  - Outfitting requirements
    • Autonomous outfitting
E&C Focus Group Mission

**Overarching Goal:** Help NASA set the stage for RFPs for ~2030 lunar base development.

- Build alliances with industry and academia.
  - Conduit to enhance public-private partnership.

- Enhance and smoothen interaction between industry and NASA.
  - Help develop RFI and RFP that are easily understood by all.
  - Recommendations for funding through various avenues such as SBIR, STRG, LuSTR, etc.

- Help NASA in technical areas as systems integrator.
  - Exploit our proximity to other focus groups.
  - Perform technology assessment, gap analysis, etc.
LSIC Fall Meeting Nov. 3-4th
Autonomy and Robotics

• Hybrid meeting planned – 100 people in-person limit
• Keynote address by NASA Associate Administrator Pamela Melroy
• First day focuses on networking and community building, including invited early career speakers, venture capitalist panel, small business development panel, and community-submitted talks and posters
• Second day focuses on robotics and autonomy needs for establishing, operating, and maintaining a sustained presence on the lunar surface
• NASA will share information on robotics and autonomy investments. Community will engage in breakout sessions to assess gaps and critical investments needed.

LSIC meetings enable ongoing technical discussions between NASA and the community

- **Bi-Annual Meetings** (Spring and Fall)
  - Fall Meeting November 3-4th, Bowie State University (Hybrid)

- **Monthly Focus Group Meetings**
  - 2nd Tuesday of the Month 3:00-4:00 pm – Extreme Environment
  - 2nd Thursday of the Month 3:00-4:00 pm – Extreme Access
  - 3rd Wednesday of the Month 3:00-4:00 pm – ISRU
  - 3rd Thursday of the Month 12:00-1:00 pm – Dust Mitigation
  - 4th Thursday of the Month 11:00 am-12:00 pm – Surface Power
  - 4th Wednesday of the Month 2:00-3:00 pm – Excavation and Construction

- **Thematic Workshops** (as identified by FGs and NASA POCs)
  - Examples: Supply and Demand for ISRU, Power Beaming, PNT