Lunar Surface Innovation Consortium

Joint E&C – Dust Mitigation Monthly Meeting

http://lsic.jhuapl.edu/

April 27, 2022

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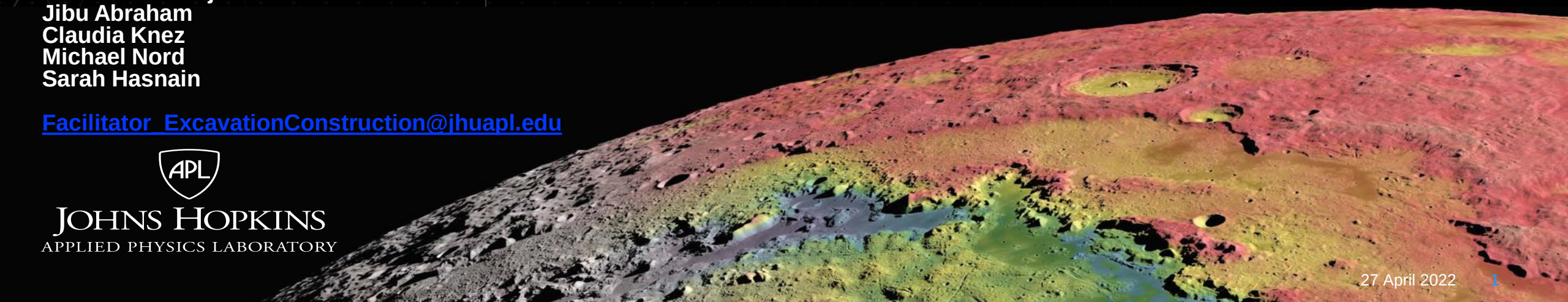


Friendly Reminders

- Recordings will be posted on our website.
  (http://lsic.jhuapl.edu/Focus-Areas/Excavation-and-Construction.php)
- Please post your questions in **Q&A** (not chat) **.**
- Mute yourself if you are not speaking.

Today's Agenda

- Focus group updates.
  - E&C
  - Dust Mitigation

- Kristin Jaburek - Modular Open Systems Approach (MOSA) questions.

Featured Talks

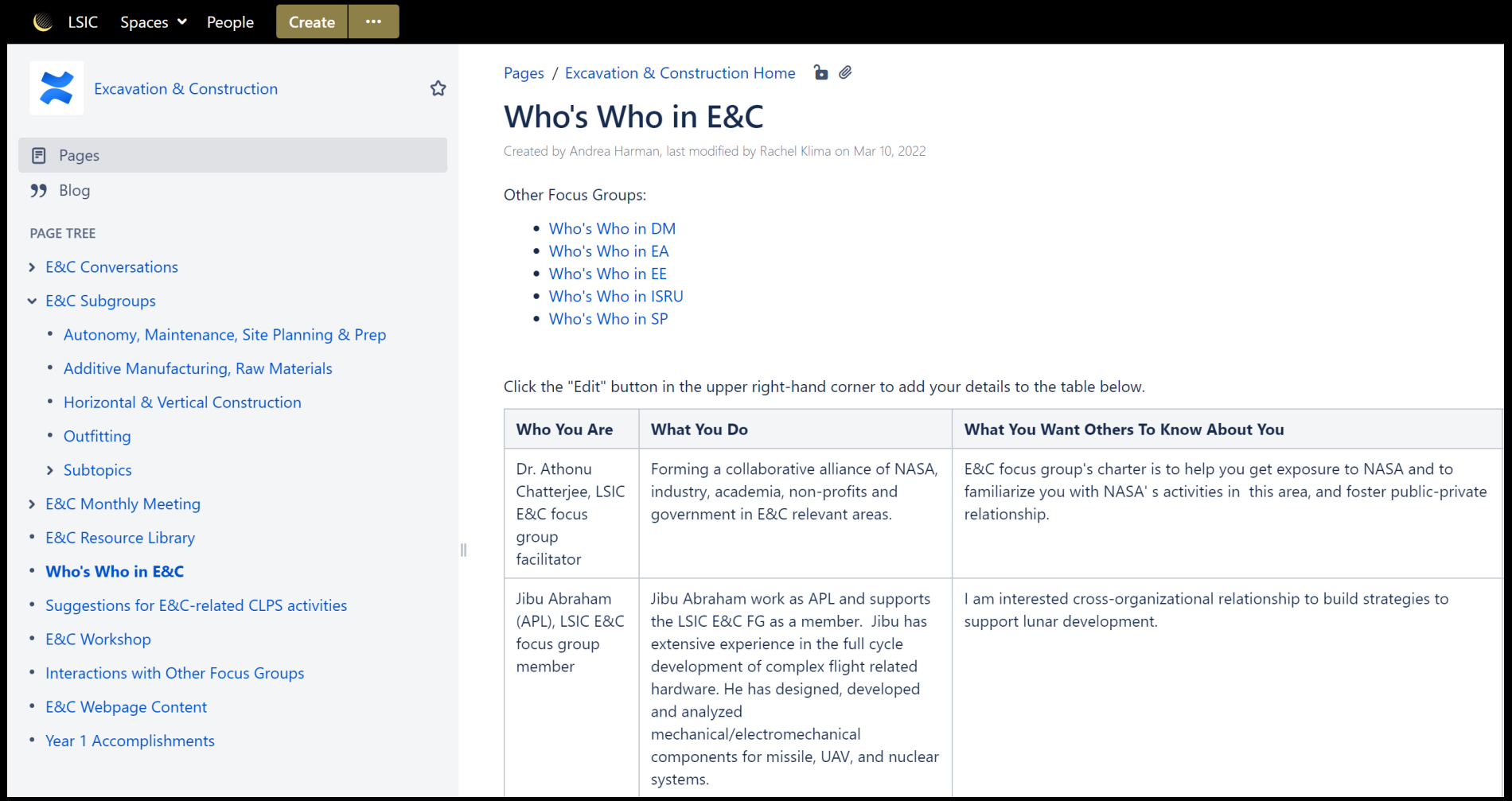
Dust-Tolerant Mechanisms	15 min	Vincent Vendiola *Honeybee Robotics*
How the mining industry mitigates dust, wear and abrasion	15 min	Brad Blair *Moonrise Mining Inc.*
Q&A + Discussion	15 min	Vincent & Brad

Theme: Designing Dust Tolerant Systems for E&C

- How does dust affect design and performance of E&C systems?
  - Lunar surface demonstrations?
- How to design machines and mechanisms for wear and abrasion?
  - Learning from terrestrial experience.
- How are repair and maintenance considerations shaped by dust?

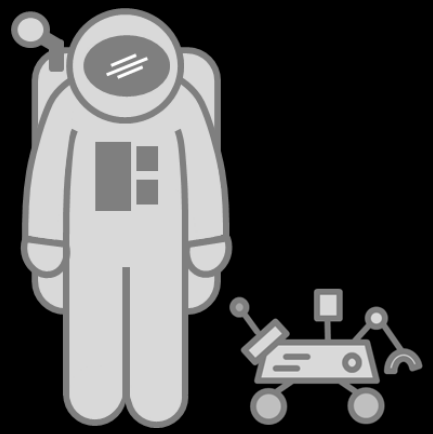
E&C Confluence Page: Who's Who

https://lsic-wiki.jhuapl.edu/pages/viewpage.action?pageId=6260179

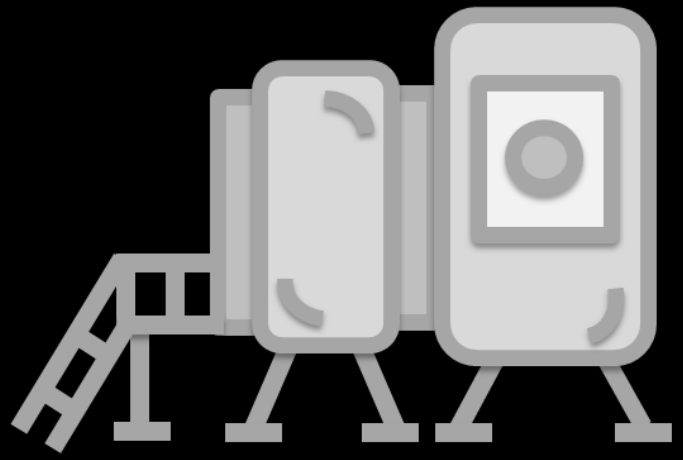


Integrated Dust Mitigation Strategy

SURFACE OPERATIONS

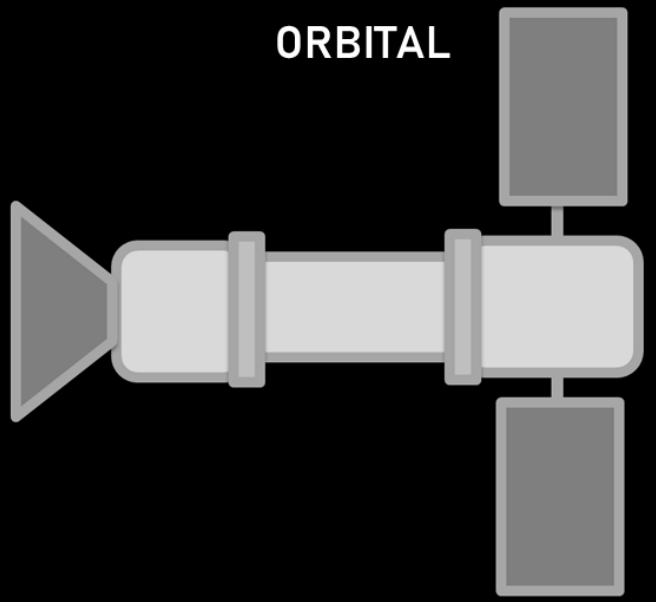


HABITATS



DESCENT/ASCENT

ORBITAL



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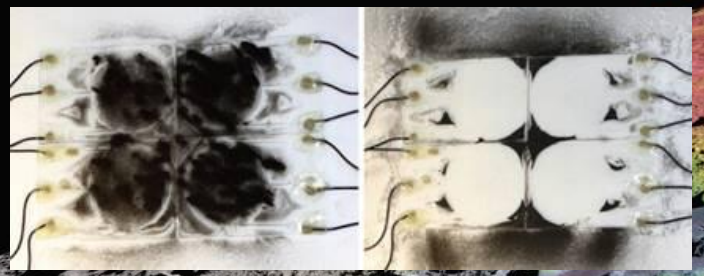
C O N S O R T I U M

Dust Mitigation FG Subgroups

- Materials and Surface Coatings:
  - *Optical Systems* – Viewports, camera lenses, solar panels, space suit visors, mass spectrometers, other sensitive optical instruments
  - *Thermal Surfaces* **–** Thermal radiators, thermal painted surfaces, thermal connections
- Seals, Soft Goods, and Fabrics:
  - *Fabrics* – Space suit fabrics, soft wall habitats, mechanism covers
  - *Seals and Soft Goods* – Space suit interfaces, hatches, connectors, hoses
- Mechanisms:
  - *Mechanisms* – Linear actuators, bearings, rotary joints, hinges, quick disconnects, valves, linkages
- Monitoring and Filtration:
  - *Gaseous Filtration* – Atmosphere revitalization, ISRU processes
  - *Dust monitoring* – Cabin and external dust monitoring
- *Modeling: – Dust plume modeling*
- *Lunar Surface Modification* – Lunar landing pads, dust free zones and workspaces
- Isolation Technologies – Technologies that keep dust out

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Lunar Dust & Impact on E&C

- “The Moon’s dust is made up of ultra-tiny grains — formed by millions of years of meteorite impacts that repeatedly crushed and melted rocks, creating tiny shards of glass and mineral fragments.
- Not only can they travel at hurricane-like speeds, but they also cling to all types of surfaces, not only because of their jagged edges, but also because of their electrostatic charge.” [Source: NASA]

There are many possible impacts of Dust on E&C. Systems and subsystems affected:

- *Optical Systems* – Solar panels, windows, other sensitive optical surfaces
- *Thermal Surfaces* – Thermal radiators, thermal painted surfaces, thermal connections
- *Fabrics* – Covers (mechanisms, thermal, connectors) and external fabric coatings
- *Mechanisms* – Linear actuators, bearings, rotary joints, hinges, quick disconnects, valves, linkages
- *Seals and Soft Goods* – Connectors, hoses, power cables
- *Tools* – Cleaning tools
- *Lunar Surface Modification* – Dust free zones and workspaces

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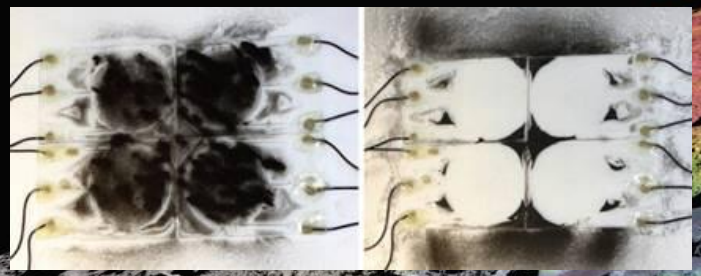
Dust Mitigation Approaches

- ***Architectural and Operational***
  - Stowage of solar arrays or covering of optically sensitive surfaces during redeployment
  - Deployment on dust free zones
  - Slower movements to reduce uplifting of dust
- ***Passive Technologies***
  - Materials – Dust repelling materials/surfaces (charged and/or patterned)
  - Coatings/Paints – Opaque and clear dust repelling surface coatings
  - Fabrics – Dust tolerant covers
  - Seals and Soft Goods – Dust tolerant connectors, hoses, power cables
- ***Mechanisms***
  - Dust tolerant actuators, bearings, rotary joints, hinges, quick disconnects, valves, linkages
- **Active Technologies**
  - Electrostatic and plasma ion beams
  - Electrodynamic Dust Shield (EDS)
  - Wireless power transfer
  - Cleaning tools such as jets and brushes



LSIC Activities

Recent and Upcoming LSIC Meetings and Workshops (https://lsic.jhuapl.edu/Events/)

- LSIC Spring Meeting (05/04-05/05) – Virtual & In-Person
  - Agenda Available Here: https://lsic.jhuapl.edu/Events/Agenda/index.php?id=200
  - LSIC Focus Group Reports @ 1:50pm EST on Thursday, 4/5
- Dust Mitigation FG Meeting (05/18)

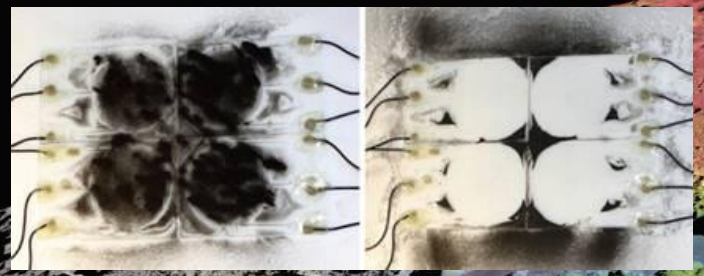
Other Recent and Upcoming Dust Mitigation Related Workshop and Meetings

- LSIC Extreme Access (EA) and Extreme Environments (EE): **Designing for the Extremes Workshop** (Virtual – Monday, 6/6)
  - Half-day virtual workshop to talk through the many challenges associated with regolith excavation and transport.
  - https://lsic.jhuapl.edu/Events/Agenda/index.php?id=232
- **Space Resources Roundtable XXII Meeting** (Colorado School of Mines in Golden, CO, USA – Tuesday 6/7 – Friday 6/10)
  - The 22nd SRR meeting will present innovative approaches in space resource identification, technology development, utilization, public and private partnerships, and capability and regulatory regimes.
  - https://lsic.jhuapl.edu/Events/Agenda/index.php?id=199

Lunar Surface Innovation
C O N S O R T I U M

Keep up-to-date about Dust Mitigation!

- Sign-up to Receive LSIC and Dust Mitigation FG Updates:
  - Fill out the LSIC Survey and indicate interest in Dust Mitigation to receive news and event invitations:
  - https://lsic.jhuapl.edu/News/Sign-Up.php
- Help us improve the Dust Mitigation Focus Group!
  - Feedback survey: https://docs.google.com/forms/d/e/1FAIpQLSdjuTIK_TLMnCM4_aSMLAzLS762qtzbgmcOd2fgizICsab6KQ/viewform
- Join one of the Dust Mitigation Subgroups!
  - Dust Mitigation Subgroup Membership/Leaders survey: https://docs.google.com/forms/d/e/1FAIpQLScB6iT2fgPqj2zIaP0s-rwWQDQ04TPfgVyiC5zn0AQPAT5CZA/viewform
- Interested in Teaming/Collaborating with Others?
  - Add yourself to our Who's Who page: https://lsic-wiki.jhuapl.edu/display/DM/Who%27s+Who+In+Dust+Mitigation
- Looking for info on lunar dust or dust mitigation resources?
  - Checkout our resources page on the Dust Mitigation Wiki page on Confluence: https://lsic-wiki.jhuapl.edu/x/94Rf

LSIC | MOSA Working Group

Lunar Surface Innovation CONSORTIUM

- Today's MOSA Questions
  - Within this capability area, what would you designate as a critical interface?
    - What is the boundary that interfaces with the larger system?
  - What are the existing efforts on standards/interoperability in this area? Are they applicable to the Moon?
  - What do you want to get out of the MOSA working group?

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