



Lunar Surface Innovation

C O N S O R T I U M

Extreme Access Focus Group Telecon

March 10, 2022

We'll start around 3:03-3:05

Dr. Angela Stickle
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JHU Applied Physics Laboratory

Facilitator_ExtremeAccess@jhuapl.edu



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Today's Agenda

- LSIC Updates
- Upcoming Meetings/Opportunities
- Subgroup Updates
- Open floor and Discussion and/or Networking rooms!

<https://lsic-wiki.jhuapl.edu/x/r5AxAg>

10 March 2022

Created by Angela Stickle, last modified less than a minute ago

Add a comment below to sign in and discuss.

Please add yourself to the [Who's Who](#) if you haven't had a chance. Feel free to add any info about what you're hoping to get out of the LSIC network (collaborations, etc) in "other comments"

[Check out the LSIC Facilities Database!!](#)

If you would like to continue to discussion of MOSA opportunities relevant to EA, please join the conversati

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!

Agenda:

LSIC Updates

Subgroup Updates

[Technology Spotlight](#): Brad Buckles (NASA KSC) about the RASSOR (Regolith Advanced Surface Systems Operations Robot) project and ROS.

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Confluence is an important resource to provide asynchronous discussion opportunities and a record of conversations



Write a comment...



LSIC Updates

Funding Opportunities

- NSF SBIR/STTR Phase I Solicitation
 - Proposals due March 23 2022
 - <https://www.nsf.gov/pubs/2022/nsf22551/nsf22551.htm>
- Release of NASA Space Technology Mission Directorate - Early Career Faculty
 - Proposals must address one of the following topics:
 - Topic 1 – Development of Lightweight Solar Sail Attitude Control Technologies
 - Topic 2 – Hibernation and Recovery of Solar-Powered Systems for Lunar Missions
 - Topic 3 – Tailorable Composite Design Concepts towards Dimensionally Stable Structures
 - Notices of Intent Due: March 2, 2022
 - Proposals Due: March 31, 2022
 - <https://nspires.nasaprs.com/external/solicitations/summary.do?solId={BF27BB84-C93F-9D37-4FFE-8790D23AD076}&path=&method=init>
- Please visit LSIC website for full list
 - <http://lsic.jhuapl.edu/Resources/Funding-Opportunities.php>



Upcoming Meetings

- Focus Group Telecons (2nd Thursday each month, 3-4 pm EST)
 - [March 10, 2022](#) (This is during LPSC)
 - April 14, 2022
- LSIC's Spring Meeting
 - Event Date: May 4-5, 2022 (hybrid)
 - <https://lsic.jhuapl.edu/Events/Agenda/index.php?id=200>
- AIAA ASCEND Conference
 - October 24-26, 2022 in Las Vegas, NV
 - Call for Content now open! Propose a session or submit an abstract
 - Deadline: March 31, 2022
 - <https://www.ascend.events/call-for-content/>

There will be a joint EE/EA workshop June 7 (TBF). Stay tuned for more information!

Subgroup Meetings

- PNT Subgroup meeting: March 17, 2022 (3pm ET)
- Comms: March 16, 2022 (1 pm PT/4 pm ET)
- Mobility: March 24, 2022
- TRN: stay tuned!

We'd like to have a discussion of subgroups, and what you are finding most useful (or would like to see included/changed) in the next few months... please take a few minutes to think about the groups!

We'll be putting out a survey for finishing up year 2 soon and want your feedback!

Reminder: LSIC | MOSA Working Group

- **LSIC Modular Open System Approach (MOSA) Working Group**

- Goal:

- Document community feedback on recommended lunar MOSA activities
 - Compile existing efforts and identify overlap
 - List systems that could benefit from MOSA
 - Perform system decompositions to find critical interfaces & what requirements are needed to ensure interoperability

- Plan

- Each LSIC focus group is participating and has a POC
- Cross focus group participation is encouraged

- Points of Contact

- Lead/Coordinator: James Mastandrea
- System Engineer: Kristin Jaburek
- Dust Mitigation: Jorge Núñez
- Excavation & Construction: Claudia Knez
- In Situ Resource Utilization : Jodi Berdis
- Surface Power: Samantha Andrade
- Extreme Environment: Jamie Porter
- Extreme Access: Angela Stickle



Remember we have a
Confluence page to facilitate
discussions
[https://lsic-
wiki.jhuapl.edu/x/sIMxAg](https://lsic-wiki.jhuapl.edu/x/sIMxAg)

Reminder: LSIC | MOSA Working Group

- **LSIC Modular Open System Approach (MOSA) Working Group**

- Goal:

Document community feedback on recommended Lunar MOSA activities

What are ways you would like to be involved in these discussions?

Or best ways to provide feedback to us?

- Each LSIC focus group is participating and has a POC
- Cross focus group participation is encouraged

- Points of Contact

- Lead/Coordinator: James Mastandrea
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LSIC Power User Survey Report



Motivation

- To ensure sustainable lunar exploration, a **comprehensive understanding of power** is required so that necessary power technologies are developed and can support lunar surface activities.
- LSIC Surface Power Focus Group conducted a **Power User Survey** to capture the power needs of the technologies and systems that will be used for lunar exploration.

Impact

- Results from this survey can inform the other LSIC Focus Groups and allow them to reassess their own power estimates, leading to more **cohesion and uniformity across LSIC**.
- For NASA's Science Technology Mission Directorate (STMD), understanding the state of the community's needs will enable more appropriate **gap/closure plans, targeted solicitations, and technology investments**.

LSIC Power User Survey Report



Results

- In one year of continuous work, technology developers reported that:
 - 50,000 tons of regolith could be excavated using 430 kW
 - 100 tons of O₂ could be produced with 1 MW
 - 100 tons of H₂O could be produced with 100 kW
- During the lunar night, ~65% of responders intend to be fully operational. This may become challenging, as power availability will decrease substantially during periods of darkness.
 - **Technology developers may need to reassess the amount of power they will require during lunar night, and should consider viable options for minimizing their power demands during hibernation.**

Some Recommendations to NASA

- Appropriate **scales of power** will enable lunar activities; reasonable primary increments to consider are **10 kW, 50 kW, and 200 kW**
- Rather than simply trying to meet the power demands as stated, STMD should consider **examining system-wide solutions** for austere operations during periods of darkness.
 - This can inform secondary energy storage and non-solar generation (e.g. fission surface power) necessary for sustained presence.
- High-level requirements are needed in order to assess if the **yearly outputs of technologies in development are sufficient** for mission success. STMD should communicate **status updates of roadmaps as transparently and rapidly as possible** to enable the community to target appropriate scales for development.

LSIC Power User Survey Report



Power users are encouraged to update the information for a technology that they have previously reported, and/or add a new technology using this Google Form:

<https://forms.gle/dcvvgpNTEUjH1UAr5>

Read the full Power User Survey Report on Confluence:

<https://lsic-wiki.jhuapl.edu/display/SP/Power+User+Survey>

Virtual “Site Visits”

- We would like to hear from you!!
- If you’re interested in having more in depth discussions with the LSIC EA team about your technology development, needs, gaps, etc... or just having a conversation and providing commentary/feedback...
- Please let us know and we can set up a virtual “site visit”
- Purpose:
 - To facilitate better understanding from the community of technology state of the art, needs, and gaps
 - To provide opportunities for direct/anonymized feedback (to LSIC and/or NASA)
 - To build up networks
- How?
 - Email Angela.Stickle@jhuapl.edu and let us know!



LSIC EA/TRN Updates

Ike Witte

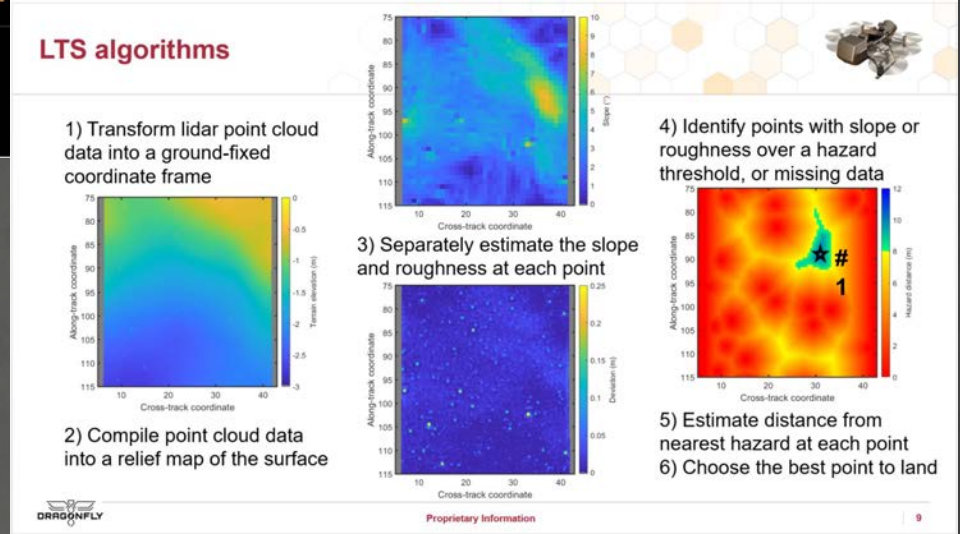
Isaac.Witte@jhuapl.edu





January Meeting: HDA, Low Altitude TRN

- Focus on hazard detection and avoidance, with a presentation from APL's Carolyn Sawyer
 - Explained Dragonfly's Lidar Terrain Sensing (LTS) algorithms
- Following a Q&A session, a Miro board session illuminated the desire for high fidelity common datasets that can be used for algorithm development and performance analysis



• Session slides can be found at <https://lsic-wiki.jhuapl.edu/display/EA/January+Meeting%3A+HDA>



March Meeting: Hardware

- Focus on TRN hardware selection, especially as it relates to various mission risk profiles
- Presentations from JPL's Andrew Johnson and Havard Grip, leads for the Perseverance Rover and Ingenuity Mars Helicopter, respectively
 - TRN for Perseverance was critical, used rad-hard proven hardware
 - Ingenuity was a technology demonstration, and with a higher risk tolerance was able to use more flexible COTS hardware

• Session slides can be found at <https://lsic-wiki.jhuapl.edu/display/EA/March+Meeting%3A+Hardware>

Mars 2020 Terrain Relative Navigation
Hardware Overview
Lunar Surface Innovation Consortium

Dr. Andrew E. Johnson
Principal Robotics Systems Engineer
aej@jpl.nasa.gov
(818) 354-0357

Jet Propulsion Laboratory
California Institute of Technology

March 3rd, 2022

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LCAM Image: 10km altitude

Jet Propulsion Laboratory
California Institute of Technology

Visual-Inertial Navigation
for the Ingenuity Mars Helicopter

Håvard Fjær Grip
Jet Propulsion Laboratory, California Institute of Technology

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- We are in the process of setting up a presentation on rendering and simulations for TRN development/analysis
- Aiming for early April, will send information out as soon as possible!
- If you have any simulation environment questions you would like answered, or any topics to be specifically addressed, please contact me (Isaac.Witte@jhuapl.edu)



Communications Update



Annual Goal: Where are we?

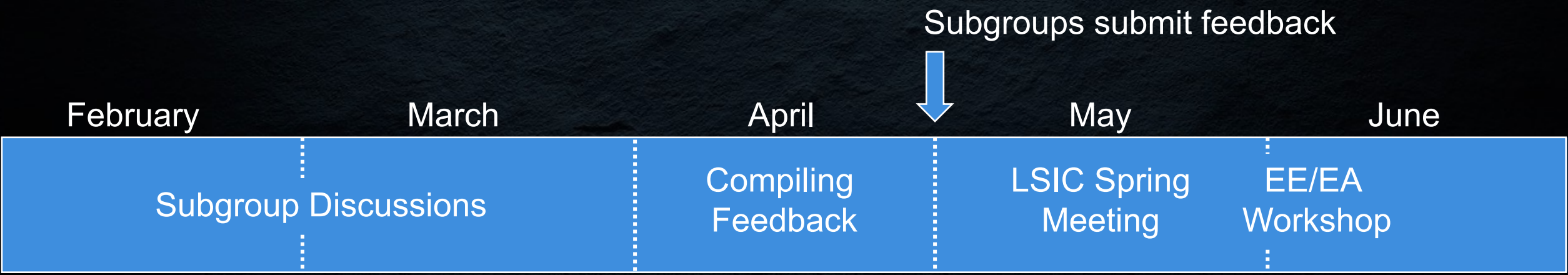
↑
We are
here
↓

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



Looking Forward

- Subgroups are the easiest place for us to build community and to have more detailed conversations
 - Conversations over the past year have ranged in topic, but address themes related to the annual goal
 - We will be collecting feedback from the subgroups in the next few months
 - This feedback and recommendations will be provided to the community and to STMD
 - Feedback can be “white paper” style or more informal
- Joint EE/EA workshop will focus on deep PSRs





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LSIC EA Annual Goal Reminder

- Identify mission/system elements needed to explore challenging lunar environments, including identifying specific technology needs and gaps, **prioritizing development timelines**, and providing a general roadmap and recommendations for needed technology, testing, and demonstrations.
 - *Permanently Shadowed Regions (PSR) and lunar pits/lava tubes were chosen as high priority environments*
 - *We will work with the EE group to identify environment requirements and challenges*
 - *Conduct at least one targeted Technical Interchange Meeting (TIM)*
- Build a community and develop collaborative relationships among members
 - Inclusive monthly telecons with member technology spotlights and invited technical talks
 - Provide networking opportunities at large LSIC meetings, mentoring through LSIC channels
 - Community-led subgroups for in depth discussions and networking

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

Focus Group Area	Listserv address	Facilitator
In-Situ Resource Utilization	LSIC_ISRU@listserv.jhuapl.edu	Karl Hibbitts
Surface Power	LSIC_Power@listserv.jhuapl.edu	Wes Fuhrman
Extreme Environments	LSIC_ExtremeEnvironment@listserv.jhuapl.edu	Jamie Porter
Extreme Access	LSIC_ExtremeAccess@listserv.jhuapl.edu	Angela Stickle
Excavation and Construction	LSIC_ExcavationConstruction@listserv.jhuapl.edu	Athonu Chatterjee
Dust Mitigation	LSIC_DustMitigation@listserv.jhuapl.edu	Jorge Núñez

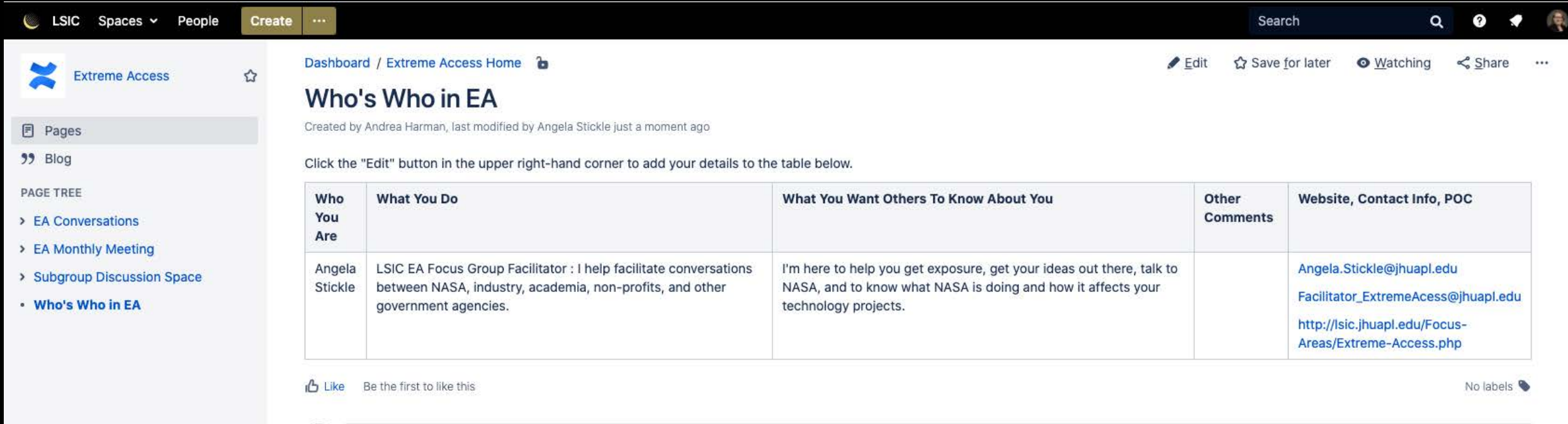


LSIC Meeting Cadence

- **Bi-Annual Meetings (Spring and Fall)**
- **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 – Excavation and Construction
- **Thematic Workshops (as identified by FGs and NASA POCs)**
 - Workshops In development Funding, CLPS Provider

Get to know the community

<https://lsic-wiki.jhuapl.edu/x/0IVf>



LSIC Spaces People Create ... Search

Extreme Access

Dashboard / Extreme Access Home

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.		Angela.Stickle@jhuapl.edu Facilitator_ExtremeAccess@jhuapl.edu http://lsic.jhuapl.edu/Focus-Areas/Extreme-Access.php

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

Who's Who in Surface Power: <https://lsic-wiki.jhuapl.edu/display/SP/Who%27s+Who+in+LSIC-Surface+Power>

Who's Who in E&C: <https://lsic-wiki.jhuapl.edu/pages/viewpage.action?pageId=6260179>

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