Fall 2026 RoSE Lab Kick-Off!

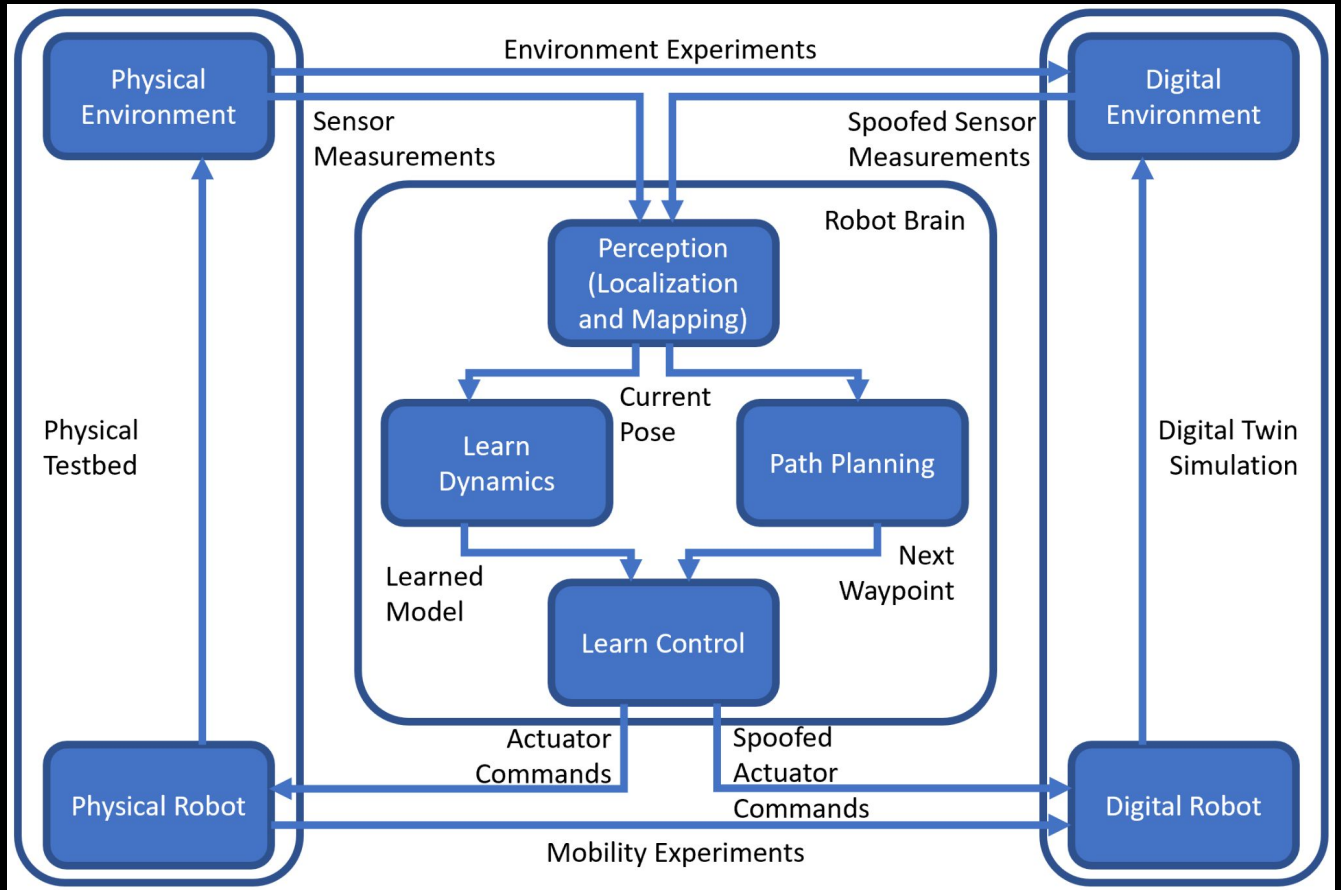
Welcome + Format
Lightning Talks
Resources + Tour

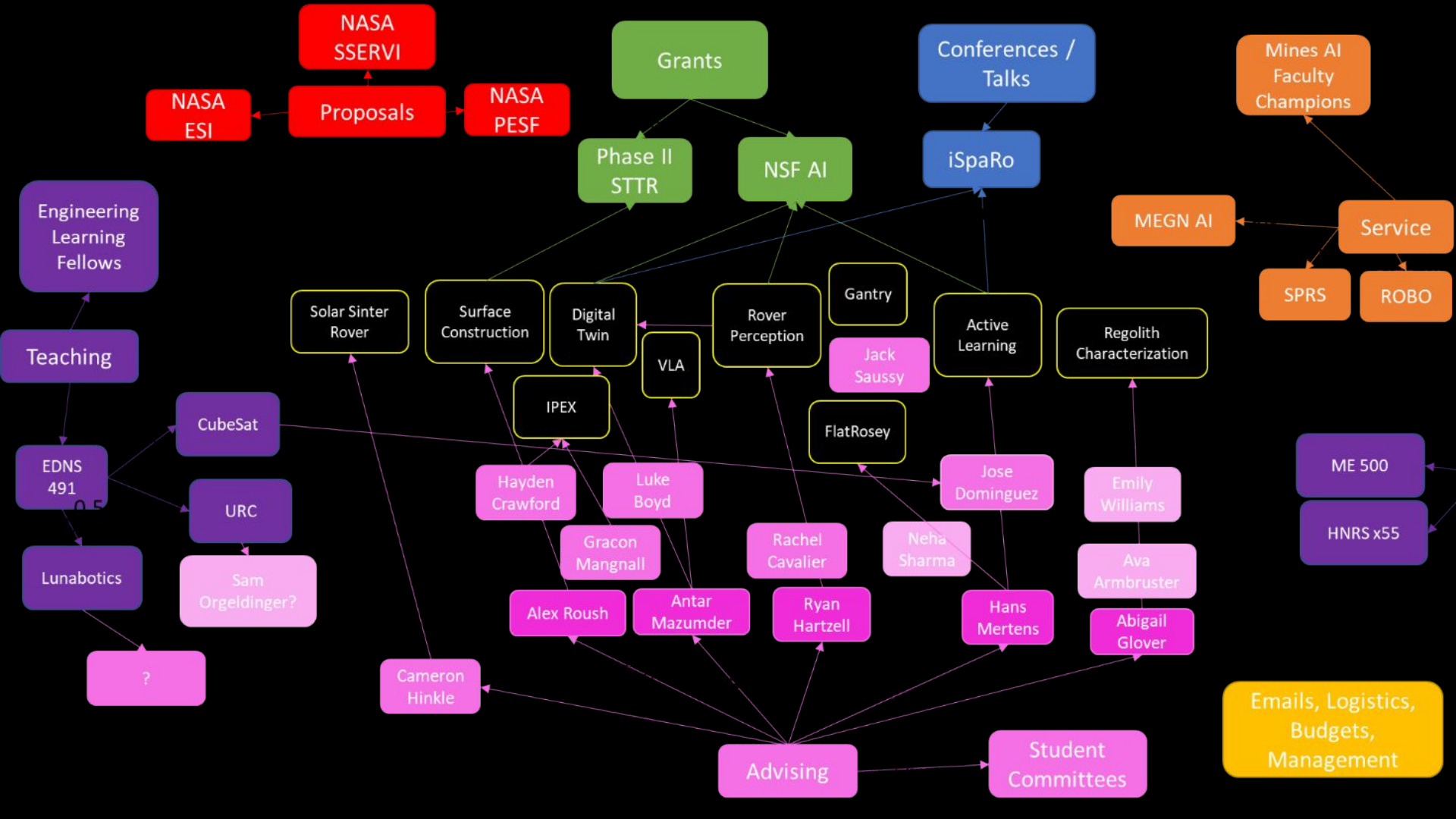
Group Meeting Format

Date	Presenter	Topic
8/24/2026	Frankie Zhu	Onboarding, research portfolio, tour
9/7/2026	NONE	Labor Day
9/21/2026	Alex Roush	Plan of IPEX Rover Experiments
10/5/2026	Antar Mazumder	VLA Design and Performance
10/19/2026	Ryan Hartzell	Perception experiment updates
11/2/2026	Abigail Glover	Geotech literature review
11/16/2026	Hans Mertens	Defense practice
11/30/2026		URC
12/14/2026		Lunabotics

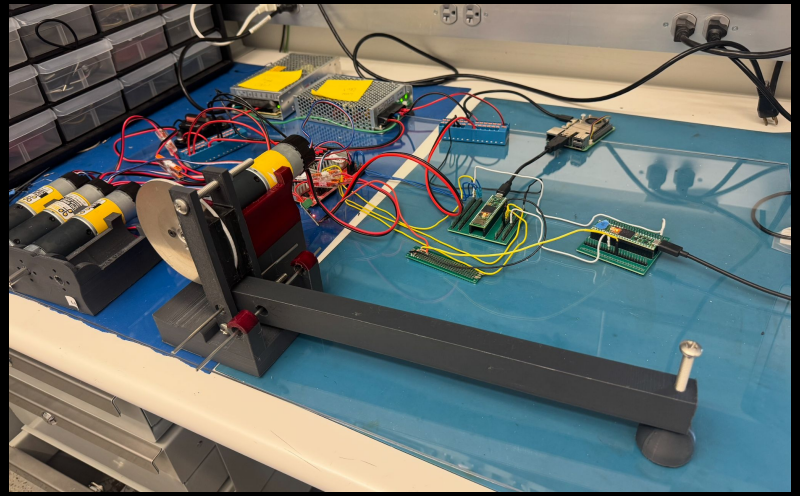
- Every other week
  - Some of you can't make the whole time. That's ok, just come when you can
- 1 hour total
  - First, 30 minutes
    - update slides, like following slide
    - Can find these slides under folder "Group Meetings > Update Slides"
  - Last 30 minutes, technical talk; will be demonstrated by veteran graduate students
    - Can always find these slides under folder "Group Meetings > Technical Talks"
- Technical talk schedule to the left
  - You can talk about nearly anything technical of interest to you. I just want you to practice presenting technical concepts
  - Best that it's relevant to your research and useful to others
  - If you need to switch, arrange it with the person in desired slot directly and update spreadsheet
  - Use your slot to practice any upcoming presentations. Be open to feedback

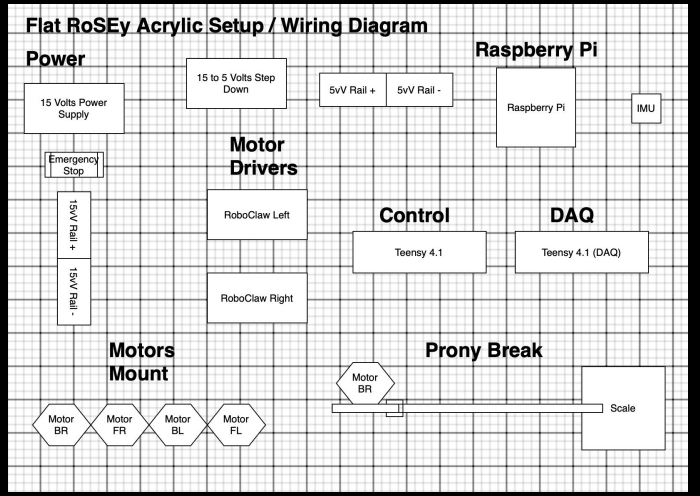
Portfolio


Physical Environment
Environment Experiments
Digital Environment
Sensor Measurements
Spoofed Sensor Measurements
Robot Brain
Perception (Localization and Mapping)
Current Pose
Learn Dynamics
Path Planning
Physical Testbed
Digital Twin Simulation
Learned Model
Next Waypoint
Learn Control
Actuator Commands
Spoofed Actuator Commands
Physical Robot
Digital Robot
Mobility Experiments


NASA SSERVI
NASA ESI
Proposals
NASA PESF
Grants
Phase II STTR
NSF AI
Conferences / Talks
iSpaRo
Mines AI Faculty Champions
MEGN AI
Service
SPRS
ROBO
Engineering Learning Fellows
Teaching
EDNS 491
CubeSat
URC
Lunabotics
Sam Orgeldinger?
?
Solar Sinter Rover
Surface Construction
Digital Twin
VLA
IPEX
Rover Perception
Gantry
Jack Saussy
FlatRosey
Active Learning
Regolith Characterization
Hayden Crawford
Luke Boyd
Gracon Mangnall
Alex Roush
Antar Mazumder
Rachel Cavalier
Ryan Hartzell
Neha Sharma
Jose Dominguez
Hans Mertens
Emily Williams
Ava Armbruster
Abigail Glover
Cameron Hinkle
ME 500
HNRS x55
Advising
Student Committees
Emails, Logistics, Budgets, Management

Flat Rosey





Timeline

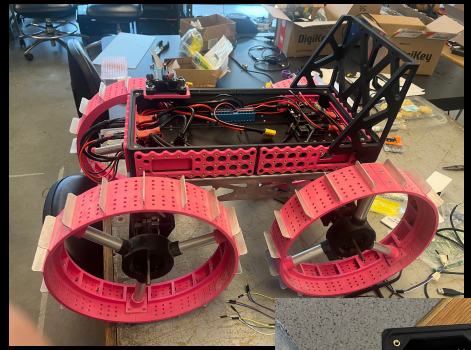
- Finished motor characterization
- Finish remaining Documentation by Sep 4
- Standardize pipeline for Testing algorithms Sep 30
- Flat RoXy?

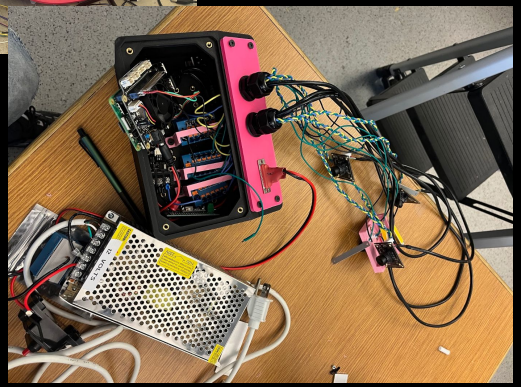
People

Lead: Neha

Hardware: Raul

Fit RoSEy





Goals:

- Ideally a system that has major breakage once a Semester / 3 months than once every few weeks
- Achieve software readiness

Outcomes:

1. Improve documentation for RoSEy for fixes
2. Eventually upgrade software and hardware

Current:

- Configure Opti-track puck
- Debug Wheel cameras

Mines Lunar Surface Sim Gantry

What is the goal?

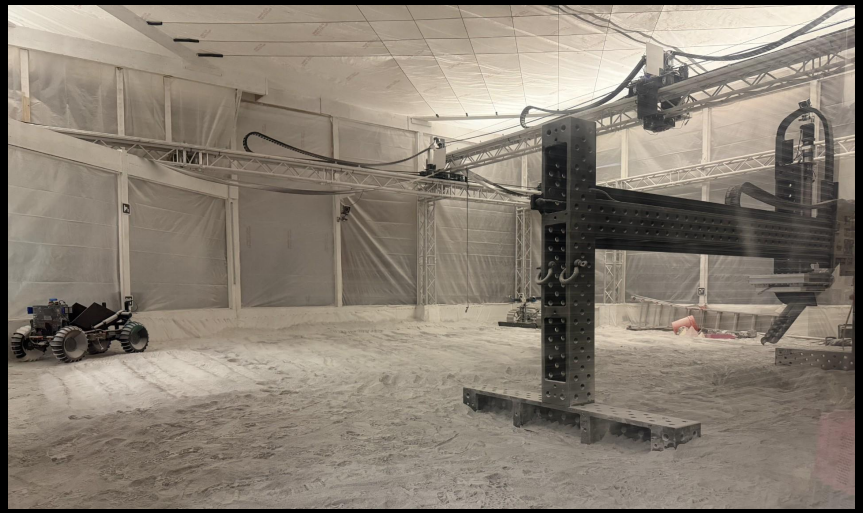
- Have the MLSS gantry operate safely to assist research through:
  - GO TO commands to move to specific coordinates in the MLSS
  - Follow above rovers on the ground to supply power

Where we at?

- Strong understanding of the system and where it is being bottlenecked
- Parts ordered to migrate the system to a more powerful computer

What's next?

- Evaluating alternative sensors for dusty environments
- Debugging and optimizing software for gantry control



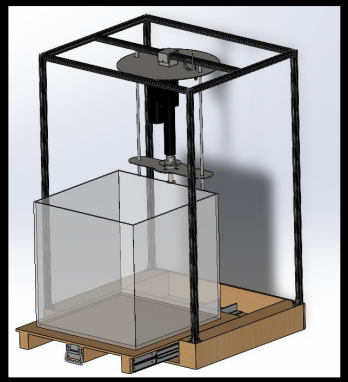
Please reach out after the meeting if you are interested in joining this project!

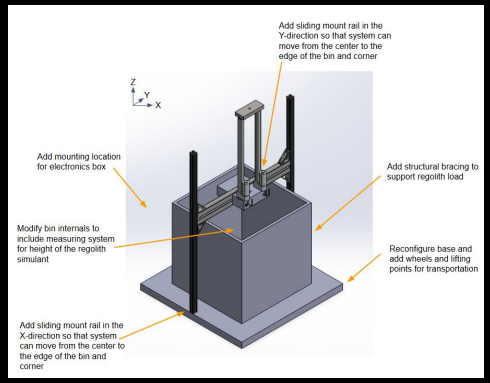
Project Lead: Jack Saussy

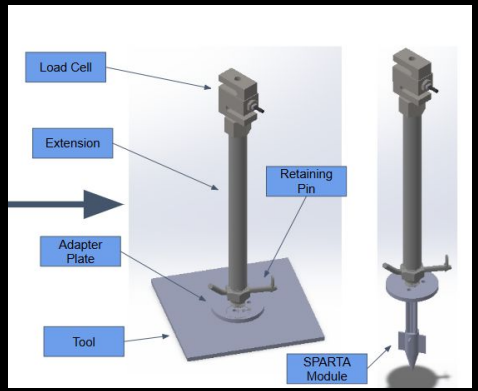
Regolith Sensor Suite

POC: Abigail Glover
abigail_glover@mines.edu

Bevameter



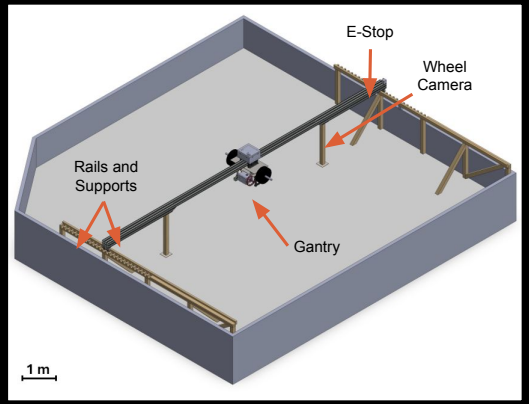


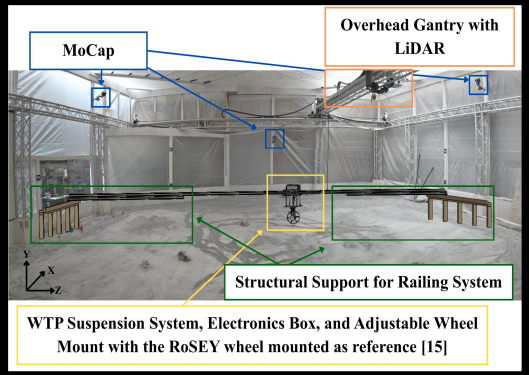


Semester Goals:
- Finalize Design
- Construct
- Boundary Conditions Test Campaign

Needs
- Testbed Design
- Test Campaign

Wheel Testing Platform (WTP)



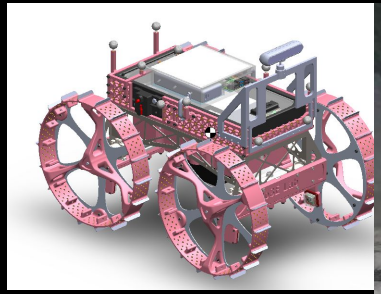


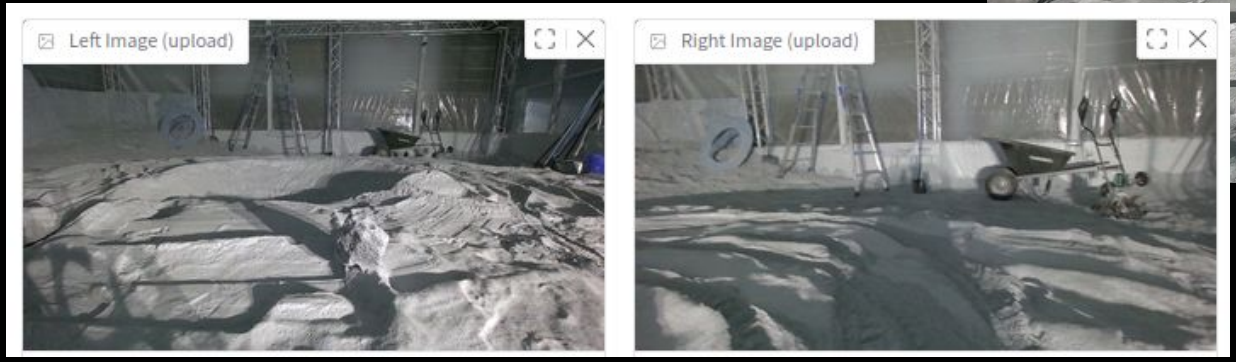
Semester Goals:
- Finalize Design
- Construct
- Verification & Validation (V&V)

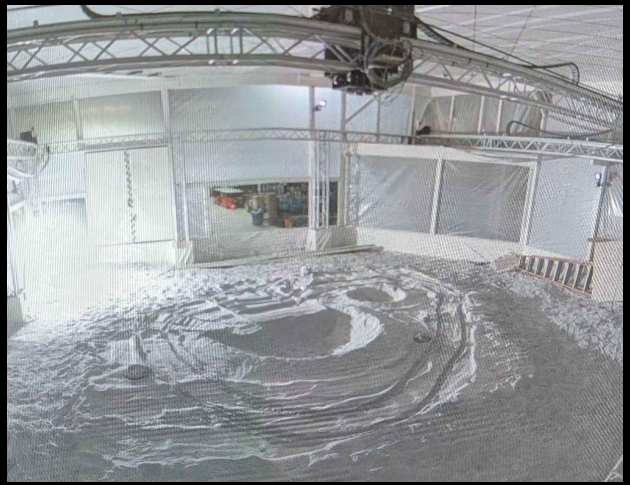
Needs
- Electronics Lead
- Electronics Team Members
- Software
- Hardware

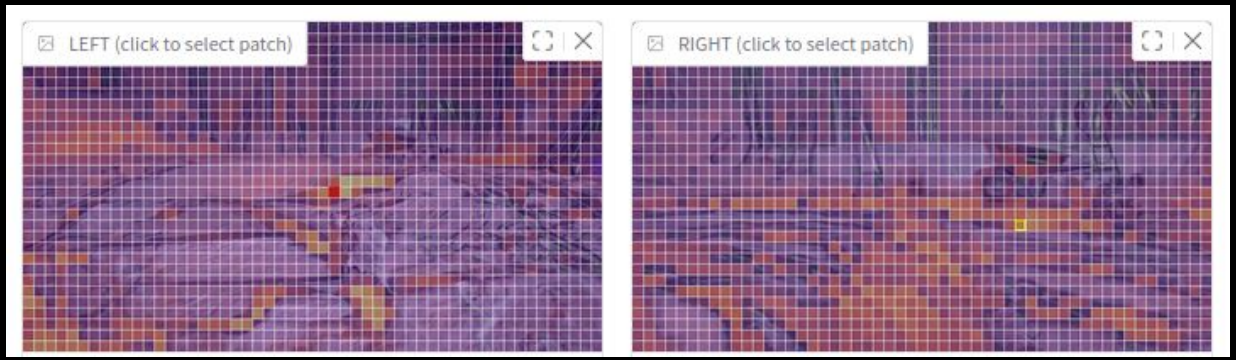
Rover Perception

POC: Ryan Hartzell
Email: ryan_hartzell@mines.edu



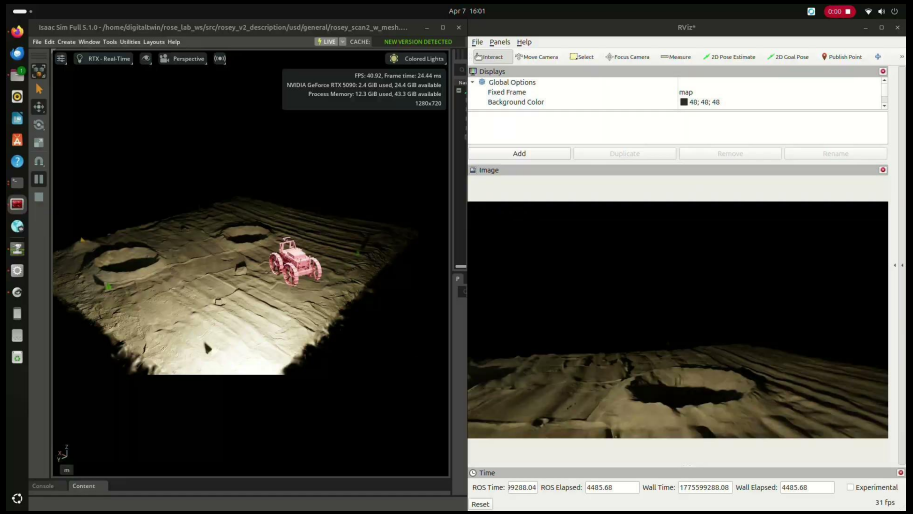




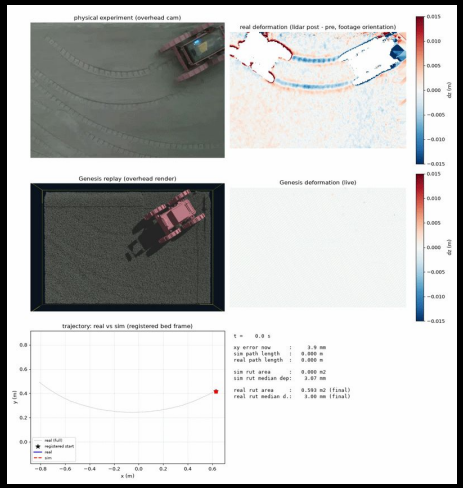


Digital Twin

What it is - *A virtual replica of the rover (e.g. Rosey) and/or target environment (e.g. Lunar Terrain)*
Team Goal - *To establish a Lunar digital twin ecosystem that is both photorealistic and granular physics response accurate*

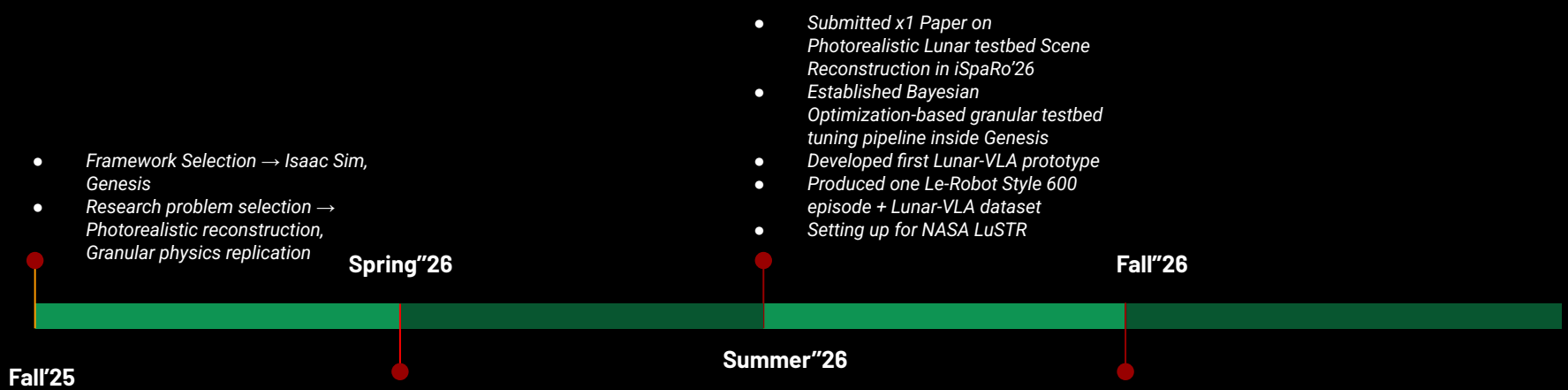


Digital twin of our rover RoSEY traversing a photorealistic Digital Twin of Mines Lunar Surface Simulator (MLSS) Testbed



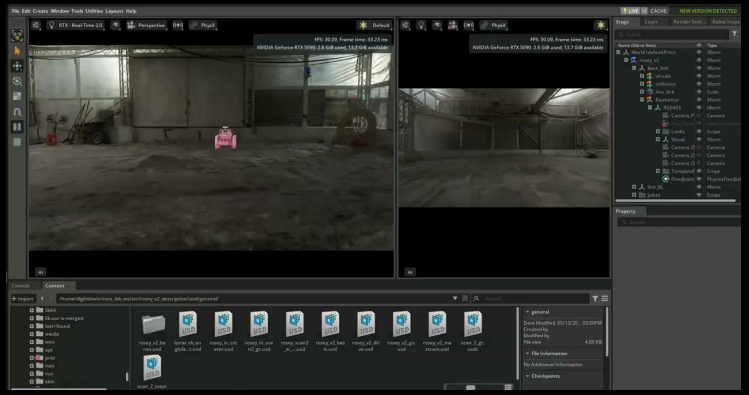
Digital Twin of RoSEY traversing a tuned digital granular media testbed with identical velocity commands

Digital Twin



Vision Language Action Model

Some Goal (Optional) → Rover Sees Something **(Vision)** → Rover reasons internally via KV Cache or in natural language (to human operator) what to do about it **(Language** *[Read Reason]* **)** → Rover does something based on reasoning **(Action)**



Model reasons to avoid craters

Model reasons to inspect craters

Note: Demonstrated traversal environments are photorealistic digital twins of MLSS

Active Learning for Rover SysID

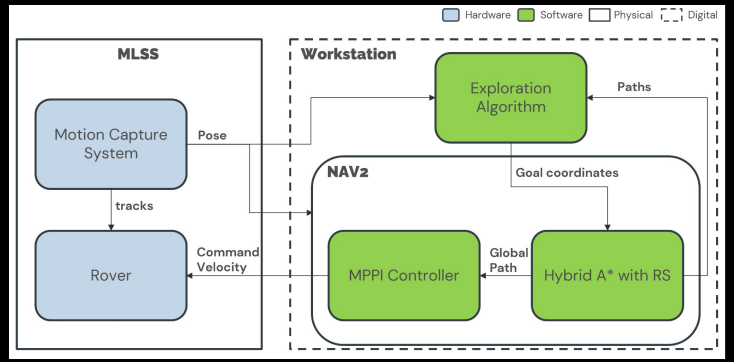
What is the goal?
- Explore unknown environment with rover
- Learn dynamics and environment simultaneously

How do we get there?
- Path planning -> explore environment
- MPPI controller-> follow planned paths

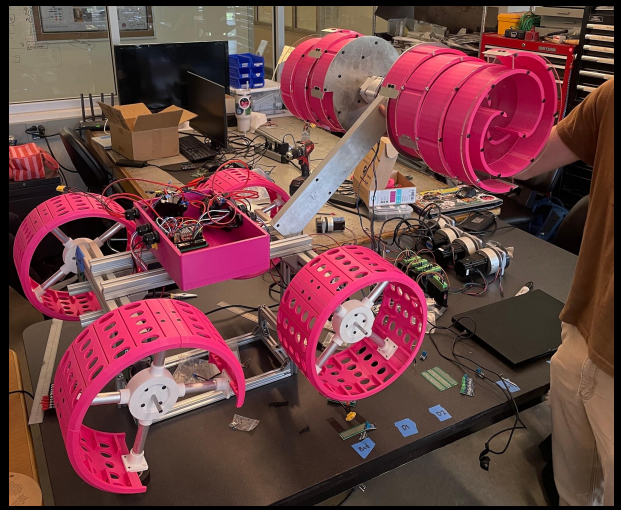
Where we at?
- Waypoint following with NAV2 works
- Kinematics model doesn't predict turning perfectly
  - Rosey can get too close to the boundaries

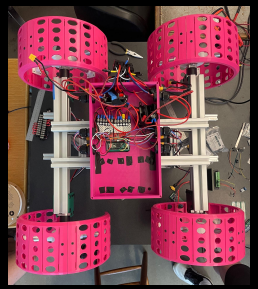
What's next?
- Learn delta to kinematics model
  - Train dynamics model from data
- Test if trajectory following is more accurate with learned model

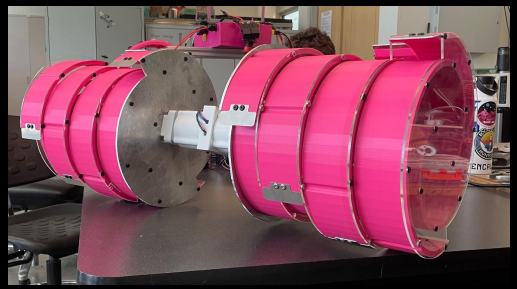
Mines Lunar Surface Simulator (MLSS)



IPEx







Goals:

- Build a 1 to 1 replica of the NASA IPEx rover for
- Get operational in the test bed ASAP
- Demonstrate simulate collection and deposition to validate our ability to construct berms for future autonomous construction research

Outcomes:

1. Produced an almost prototype rover (ran into plenty of setbacks this summer)
2. Operation in the next couple of weeks
3. Moving towards testing and validating the sensor suite on board!

Lunar Berm Construction

Analytical Cost Function

- We want to know how much time and energy it takes to build a berm
- Parameterize discrete rover action primitives to optimize construction time and energy

Construction Sequence Algorithm & Deposition Surrogate Model

- Formulate a graph-based planner (DAG) with a physics-informed surrogate model to dynamically plan and execute a berm construction sequence

Simulation Environment

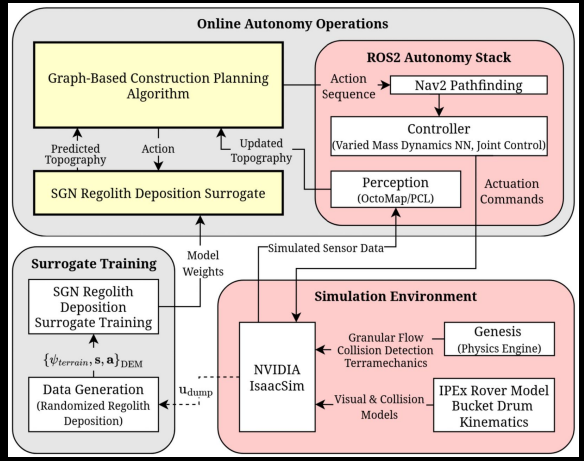
- Simulate berm construction algorithms, energy consumption, and operational time using Isaac Sim/Genesis

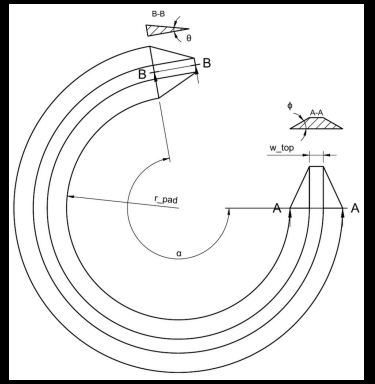
IPEx "Roxy"

- We need a baseline model to inform other aspects of the project
- Collect empirical terramechanics and power telemetry via MLSS physical testing
- Characterize motor power draw across discrete motion primitives (e.g., excavate, haul, deposit)

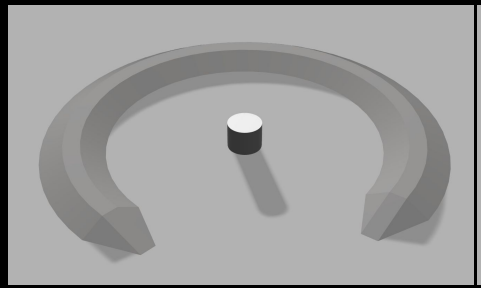
$$E_{\text{lift}} = (m_{\text{arm}} + m_{\text{load}})gL_{\text{COM}}(\sin(\theta_{\text{arm, final}}) - \sin(\theta_{\text{arm, initial}}))(\nu_{\text{arm}}^{-1}) + P_{\text{idle}}t_{\text{arm}}$$

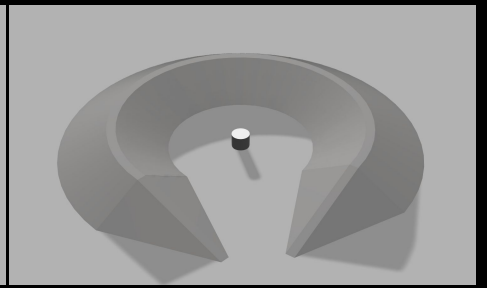
$$E_{\text{lower}} = |(m_{\text{arm}} + m_{\text{load}})gL_{\text{COM}}(\sin(\theta_{\text{arm, final}}) - \sin(\theta_{\text{arm, initial}})|\,\beta_{\text{arm}} + P_{\text{idle}}t_{\text{arm}}$$





$$V_{\text{total}} = \frac{1}{6}h\,(3\alpha(w_{\text{top}} + h\cot\phi)(2r_{\text{pad}} + w_{\text{top}} + 2h\cot\phi) + 2h\cot\theta(3w_{\text{top}} + 2h\cot\phi))$$





Solar Sintering

What is the goal?

- Finish development of a closed loop feedback system to melt regolith simulant into uniform sheets
- Collect data to validate system and publish paper with Outward Robotics

Where we at?

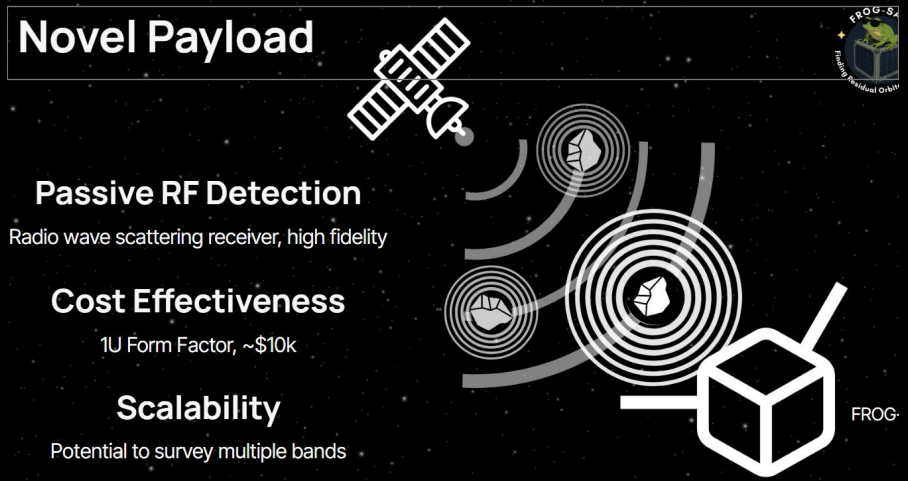
- Arm hardware is complete as of May 2026
- Software stack is pretty solid, can create quality lines
  - More development for closed loop feedback with pyrometer
  - More robust planning is needed

What's next?

- Add some functionality to the software stack to make system more robust
- Data Data Data
- Writing

Lead: Jose Dominguez

FROG-SAT (CSM Cubesat Program)



Program Fall Goals

- Assemble new Capstone Team
- Establish CubeSat Club fundamentally
- Review previous team data and configure plan for semester

Wave-scattering

Develop a payload where starlink signals from space will be reflected from debris in space. Payload will receive signal from a broader scan similar to a voltage sensor. When signal is confirmed a finer scan will be made to analyze the direction of the debris.

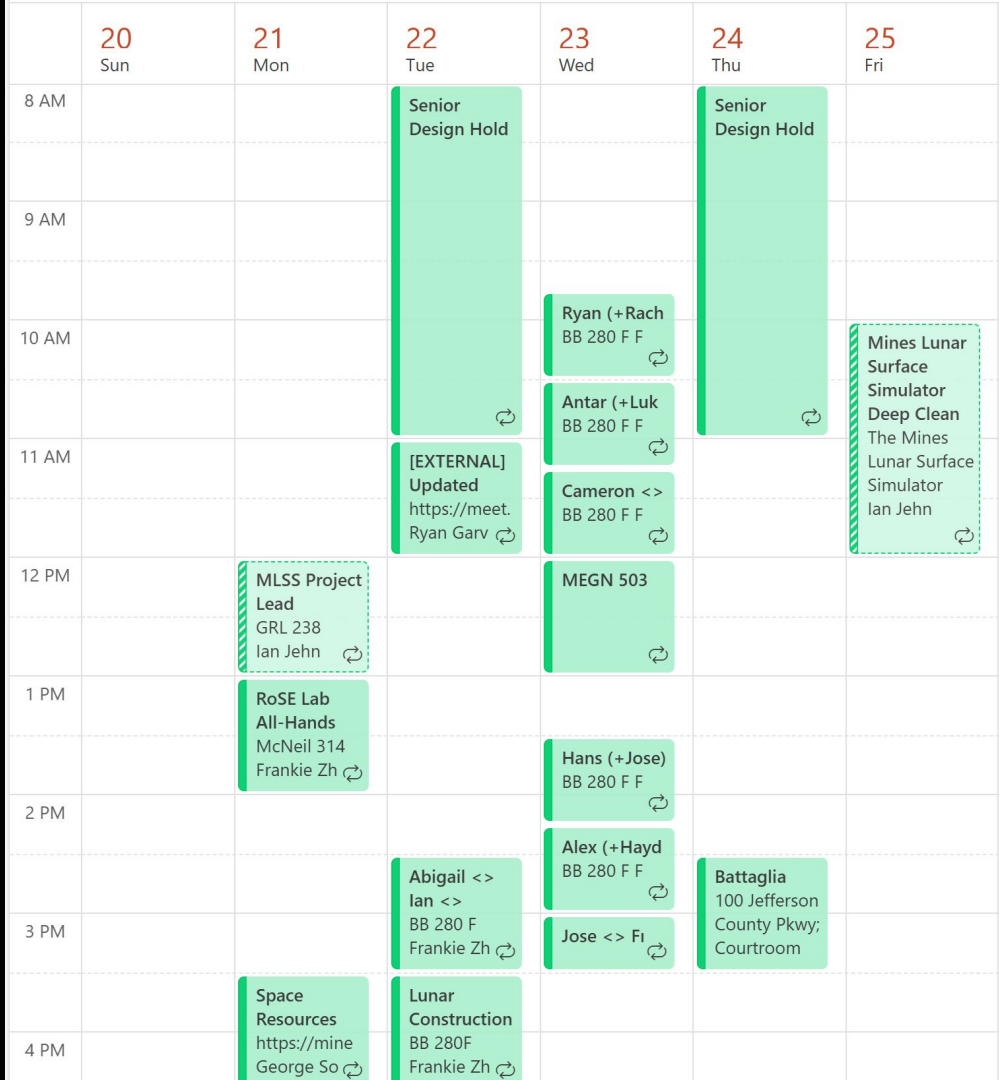
University Rover Challenge

Year Recap

- Built Oracle! - Mines' first URC rover
  - Almost made it to competition in our first year!
- Was recognized at the Senior Design Award Ceremony for...
  - Best of Award for Innovation: 2nd place
  - Most Inspiring for Future Engineers Award: 2nd place
- Tested, learned, and identified areas for improvement heading into the upcoming year
- Built a strong foundation for the next team
- Preparing to field a new senior design team this Thursday!

Fall Schedule / Registration

- First All Hands August 24 (5 days from now!) at 1 PM, Location TBD. Tech talk schedule below
  - Biweekly 1 hour
- First Lab Leads August 31st. Frankie will be gone. Jose to lead. Talk about recruitment
  - Biweekly 1 hour
- 1 on 1s scheduled. PhD student, required. Master's student upon PhD student's request.
  - Weekly 0.5 - 0.75 hours



Fall Registration

Undergrads: VIPER, MURF, or volunteer
Reminder: VIPER counts as 3 credit technical elective if 1 per semester for 3 semesters

Master's: Independent Study
Collecting department head signatures now

PhD: Graduate Thesis

General Lab Interest Form

Subject	Course Title	CRN
MEGN 503, B-R	GRADUATE SEMINAR - BioRobo	80473
ROBO 707, B	GRADUATE THESIS	82061
MEGN 707, 43	GRADUATE THESIS	82095
HNRS 155, B	VIPER ROBOTIC SPACE EXPLRTN	82121
HNRS 255, B	VIPER ROBOTIC SPACE EXPLRTN	82127
HNRS 355, B	VIPER ROBOTIC SPACE EXPLRTN	82133
HNRS 455, B	VIPER ROBOTIC SPACE EXPLRTN	82139
SPRS 707, C7	GRADUATE THESIS	82313
SPRS 707, O7	GRADUATE THESIS	82579

Resources

Expectations:

- RoSE Lab Handbook
  - Our memo of understanding (new for UGs!)

Communication:

- RoSE Lab Group Discord
  - Use each other for technical help and sounding boards.
  - I'm always a discord/email away

Spaces:

- BB 280F - Frankie's office!!!
- BB W325 - Our lab!!!
- EMI MLSS - Regolith testbed, managed by Ian Jehn
- Labriola - Fab / Maker Space

If the equipment in these spaces are not enough, I can buy you equipment. Discord me

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Tour Time - leave by 13:40

BB 280F - Frankie's office!!!
BB W325 - Our lab space!!!
GRL 140 - Residual lab space, managed by Dr. Chris Dreyer
EMI Lab - Regolith testbed, managed by Kun Zhang
Labriola - Fab / Maker Space