National Aeronautics and Space Administration

FY24 R&TD Innovative Spontaneous Concepts (ISC)

Low Risk, High Reward: Address the Decadal Survey Challenge for Autonomous Long Traverses by Augmenting a Breakthrough Mars Global Localization Algorithm for the Endurance Lunar Mission

Principal Investigator: Jeremy Nash (347)**; Co-Investigators:** Vandi Verma (1400)

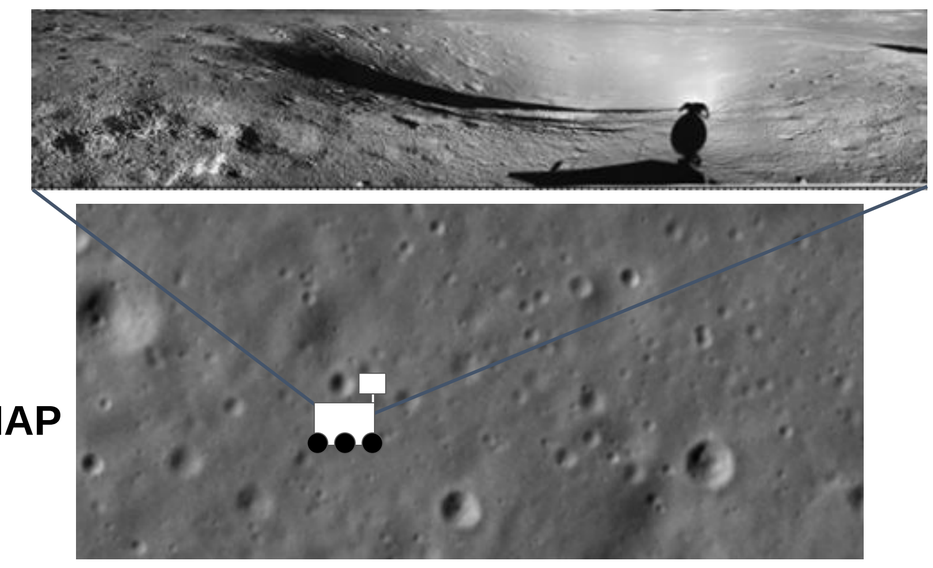
Strategic Focus Area: Innovative Spontaneous Concepts

Objectives

Create an **onboard "GPS" algorithm for lunar rovers** by matching rover images to satellite maps

Match this...
PANORAMA

to this!
SATELLITE MAP



MOON

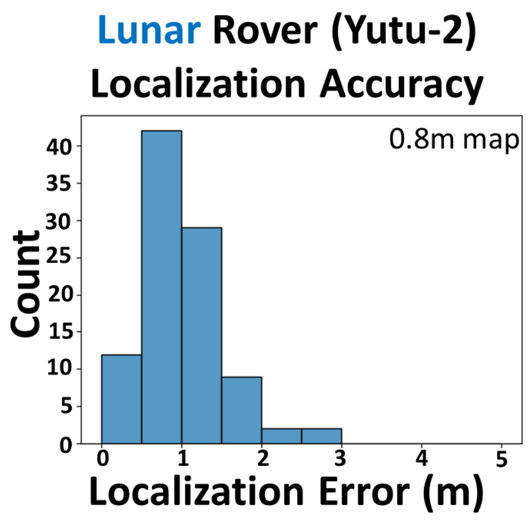
Background

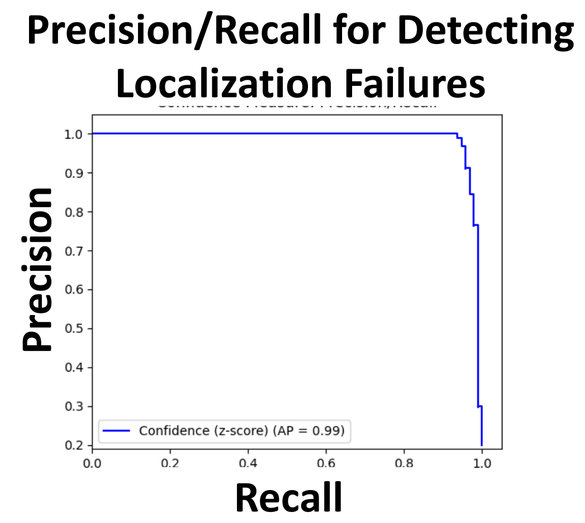
- **Lack of autonomous global localization** is one of the main barriers to longer rover traverses and required for Endurance
- **Recent breakthrough** in global localization performance and TRL on Perseverance
- **Adapt** Mars algorithm to Moon challenges

Significance/Benefits to JPL and NASA

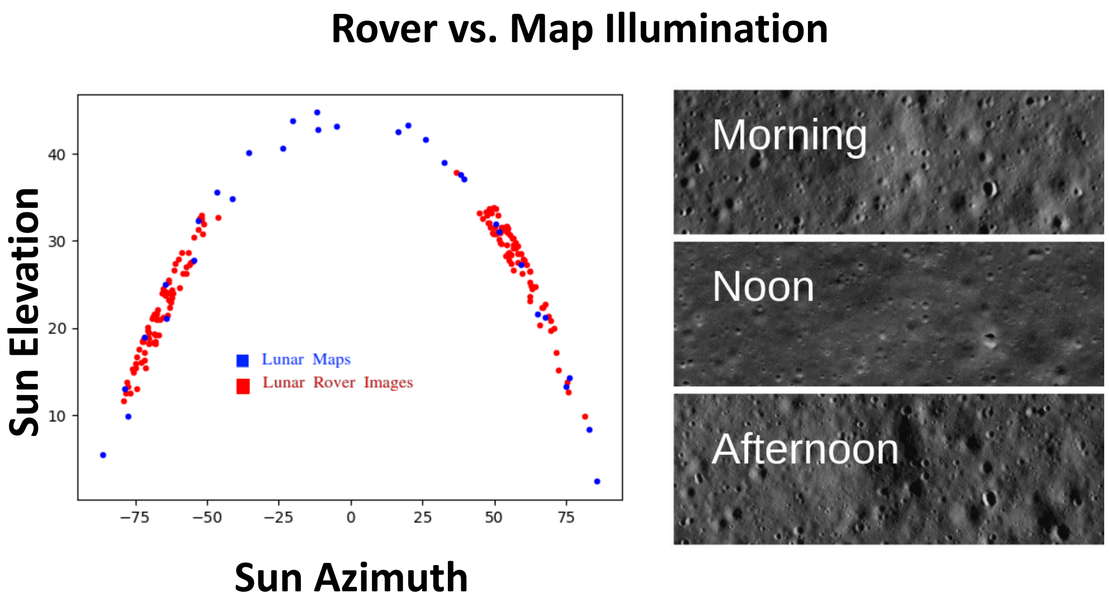
- **Decadal Survey** lists global localization as **key challenge** to enable long traverses for Endurance rover
- **Endurance** mission concept **requires** global localization for 2,000km traverse
- Funding/collaboration opportunities with Astrobotic CLPS lunar rover & NASA JSC on Lunar Terrain Vehicle (LTV)

Approach and Results





- 0.85m avg. position accuracy w/ 0.8m maps
- No significant outliers (>5m)
- Tested on 95 real Yutu-2 lunar panoramas and LROC NAC satellite images
- Confidence measures to detect localization failures (i.e. wrong search area)



- Moon illumination is a challenge vs. Mars
- Co-registered LROC NAC images with a variety of sun angles; algorithm selects LROC NAC map with most similar sun angle
- Using a 100m search radius, based on Endurance max position uncertainty

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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

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Publications:

Nash, Jeremy, et al. "Censible: A Robust and Practical Global Localization Framework for Planetary Surface Missions." International Conference on Robotics and Automation (ICRA). IEEE, 2024.
Verma, Vandi, et al. "Enabling Long & Precise Drives for The Perseverance Mars Rover via Onboard Global Localization." 2024 IEEE Aerospace Conference. IEEE, 2024.

PI/Task Mgr. Contact Information:

Jeremy Nash, (818) 669-3382, jeremy.nash@jpl.nasa.gov