Housing and Deployment Module Redesign for Distributed Lunar Sensor Deployment in the GLEE Mission

Phoebe Mertens, Samhita Donthula, Felipe Garza Cancino, Margarita Alperovich, Gavin Smith, Ethan Letendre

University of Colorado Boulder, Colorado Space Grant Consortium

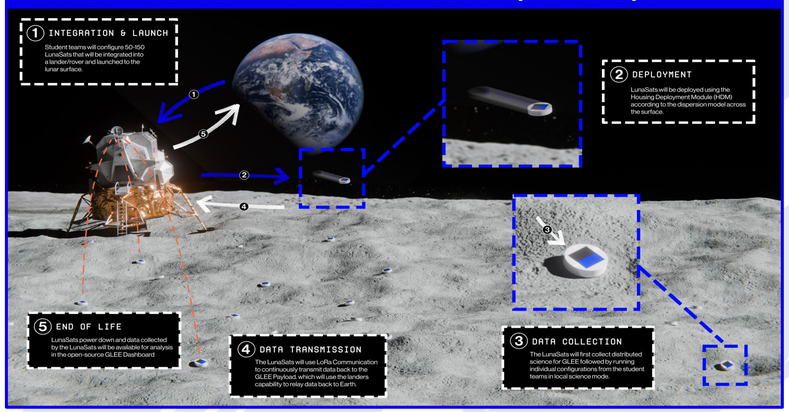
ABSTRACT

The Housing and Deployment Module (HDM) is a key subsystem of the Great Lunar Expedition for Everyone (GLEE), designed to store, protect, and deploy miniature sensor platforms (LunaSats) across the lunar surface for distributed scientific measurements. The system must meet strict constraints on mass, volume, power, and reliability while ensuring safe storage and controlled deployment of the LunaSat payload.

The current design includes a spring driven deployment mechanism, actuator and motor assembly, structural barrel, rail system, and LunaSat storage bay. These components work together to spin and release the LunaSat payload, enabling wide dispersion (~109.7 m x 48.8 m) across the lunar surface. The design incorporates mechanical energy storage, motor-driven rotation, and structural guidance systems to achieve the desired deployment pattern while maintaining structural integrity throughout launch, transit, and surface operations. Prototype testing has demonstrated the feasibility of the deployment concept, providing insight into deployment accuracy and system performance.

The GLEE Structures team is now redesigning the HDM to improve efficiency, durability, and overall mission readiness. This redesign focuses on refining mechanical subsystems, improving structural robustness, and optimizing deployment performance to better meet lunar mission requirements. Ongoing work includes structural analysis, design optimization, and prototype development.

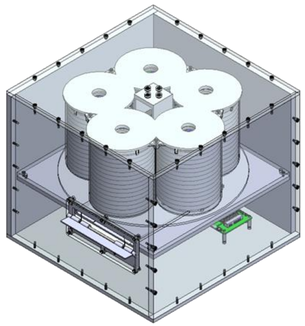
MISSION CONCEPT OF OPERATIONS (CONOPS):



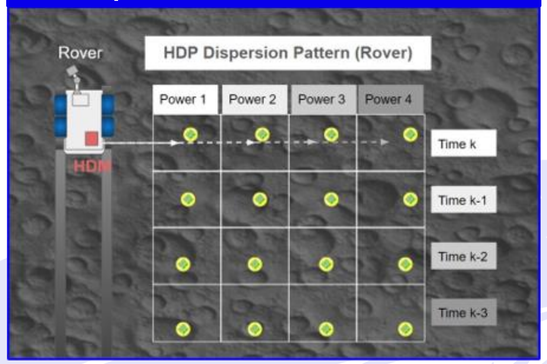
MINES LUNAR REGOLITH TEST BED

In the first half of the spring semester the Structures team focused on reconditioning the original HDM prototype to prepare for testing at The Colorado School of Mines lunar regolith test bed. The test allowed for the deployment and storage mechanism of the HDM to be tested. V.7 were deployed from the barrel of the HDM and shot onto the test bed by our flywheel motor. The test allowed for the Structures team to identify problems with the current HDM and any additional design details that want to be new redesign of the HDM.

HDM 2.0



HDP Dispersion Pattern

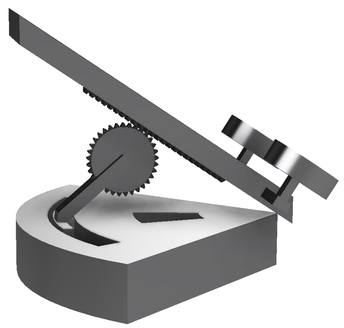


NEXT HDM PROTOTYPE

New requirements for the next iteration of the HDM create a need for multiple subsystem redesigns. The flywheel launching mechanism will now need to pitch up and down a well as yaw left and right to achieve a more precise dispersion pattern on the Lunar surface. Additionally, the HDM is increasing in volume to a 12U CubeSat and with this larger space, the GLEE team is designing to house up to 100 LunaSats to be deployed! To accommodate this increased capacity, the science team is currently running tests to determine the most efficient size and shape for storage, while preserving effective deployment and flight patterns. Previously found issues with the HDM 2.0 such as inconsistent deployment and dust proofing will be addressed thoroughly throughout the design and development phases. The structures team is excited to take this major step toward a more refined prototype that will help accomplish GLEE's mission on the Lunar Surface.

MINES TEST

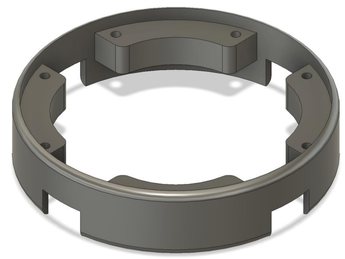
PITCH AND YAW CAD

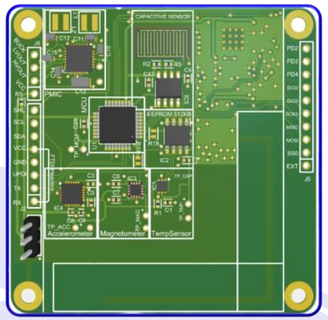


LUNASAT V8 PUCK UPDATES

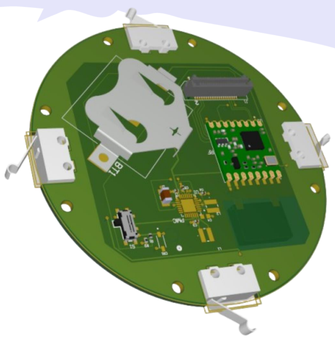
Starting with V8 of the LunaSat, the PCB board shape was changed from a square to a circular design, accommodating four switches to control power to the board. This new circular design drove part of the direction for the new storage and deployment mechanisms for the HDM, as any design had to work well with a circular LunaPuck design. Factors that went into consideration were the spin the LunaSat will have as it is ejected, flywheel placement and orientation, and vertical/horizontal storage.

LUNASAT V8 PUCK CAD





LunaSat V7



LunaSat V8

FUTURE PLANS

The next phase of the GLEE project focuses on advancing the HDM and LunaSat systems toward flight readiness through iterative redesign and integrated testing. Current efforts emphasize improving the HDM's mechanical reliability, including mitigating barrel jamming, increasing storage capacity, and enhancing durability under launch and lunar surface conditions. Additional work targets smoother deployment and the addition of pitch and yaw systems. The system will be validated through testing at lunar regolith test bed and near space environments. Summer of 2026, GLEE will be conducting a full systems testing of deployment, communication, and information retrieval on the NASA RockSat program for relevant environmental testing with more to follow.

Contact: Barbra Sobhani
Director, Colorado Space Grant Consortium
Email: barbra.sobhani@colorado.edu
University of Colorado Boulder
https://www.colorado.edu/center/spacegrant/

Want to get involved?
Scan the QR code to sign up for our LEAP (Lunar Exploration Aerospace Project) Workshop today!

Get in Touch:
Our Contact: info@glee2023.org
Website: https://www.glee2023.org/
Social Media: @gleemission