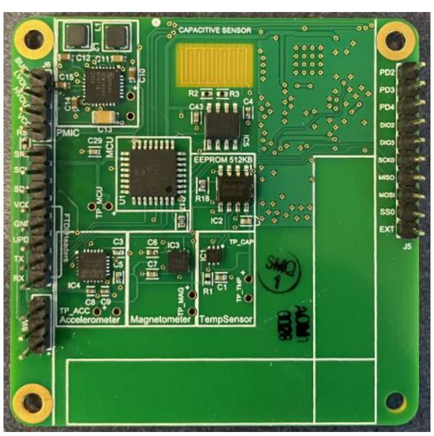
LUNAR SURFACE CHARACTERIZATION WITH THE LUNASAT SENSOR NETWORK. B. K. Sobhani[1], N. Sathiyan[2], L. Warrington[2], L. Schulz[2], R. Dwyer[2], S. Donthula[2] , P. Mertens[2] and the GLEE Team. [1]University of Colorado Boulder (Colorado Space Grant Consortium [520 UCB, Boulder, CO 80309] Barbra.sobhani@colorado.edu), [2]University of Colorado Boulder (Nikhita.sathiyan@colorado.edu).

Introduction: Understanding the properties of the lunar surface will be paramount for future mission planning, and high-resolution surface characterization can be accomplished through a deployed sensor network. The Great Lunar Expedition for Everyone (GLEE) is a catalyst for a new generation of lunar exploration engaging student teams from around the world. GLEE, initially funded through the Artemis Student Challenge, is a unique mission to demonstrate a new data collection strategy using a large network of inexpensive, student designed, sensing packages on the lunar surface. Student teams will help design the mission parameters and science cases addressed during data collection. The data will then be made available on a community science platform. GLEE will demonstrate a novel form of distributed data collection - a type of study not possible with current single-instrument missions - inspiring a future generation of space scientists by involving them in the data collection design process and helping to kick-start the next era of planetary science.

The GLEE mission will deploy hundreds of solar-powered, small sensing boards, called LunaSats, over approximately 300 square meters on the lunar surface. Each LunaSat will autonomously collect and transmit thermal, magnetic, acceleration, and regolith characterization data using a radio mesh network. The LunaSat network will allow for the investigation of magnetic anomalies, lunar seismicity, micrometeorite impact rates, thermal properties and characterization of the lunar regolith in the deployment area.



LunaSats and Lunar Deployment: The GLEE payload consists of a deployment module, on-board computer and an array of LunaSats. Students have completed the final prototype for the LunaSat for testing and validation, prior to lunar production. The LunaSat has been tested utilizing the High-Altitude Student Platform (HASP) program, particularly to test the durability of the LunaSat and the robustness of the RF communication system that the mesh network will utilize in a low temperature and pressure environment. LunaSats were tested in both wired and solar powered modes and activated during the entire approximately 11-hour flight. During the test, the LunaSats' sensor suites powered on and collected environmental data, including temperature, acceleration, and magnetic field results. The payload also successfully interfaced with multiple LunaSats and their data during flight, demonstrating the function of the LoRa (long range) RF communications system. The next step is to test the avionics and data collection and transmission system in extreme environments, ideally onboard a sounding rocket or orbital deployment.

The LunaSat Deployment Module is designed for either stationary lander or lunar rover mounting and will autonomously deploy the chipsat network in a predetermined array pattern. The LunaSats will be loaded into a storage bay for transport, once on the lunar surface, the LunaSats will drop into the circular track and be pushed out with variable motor speed controlling distance. The current LunaSat design is optimized for an equatorial deployment, based on temperature profiles and solar incidence on the solar panels for operation. Operation is planned for one lunar day. Testing and modeling are underway to determine the viability of a polar region deployment.

Testing of the sensor components has shown that they are able to gather useful acceleration, magnetic, thermal, and other regolith characterization data. We have primarily focused testing on the accelerometer with experiments that test the sensitivity and range of our sensor. One such experiment was simulating micrometeoroid impacts using the same average kinetic energy which helped outline our boundary of good usable data. Other tests were conducted using the magnetometer, one with a solenoid that was used to assess the sensor's sensitivity, and a second that subjected it to temperature fluctuations to assess the effect of temperature of the sensor's readings. Next steps include LunaSat operational efficiency and sensor sensitivity in a simulated lunar regolith testbed.

Global Student Engagement: GLEE is engaging thousands of high school and higher education students and faculty around the world in authentic lunar science, meeting the goal of the NASA Global Road Map to "Inspire and Educate" and "Create opportunities for participation in space exploration" that will stimulate international engagement in space exploration and development. Phase one of GLEE engaged international student teams through an online workshop where students learned to program and test the LunaSats, and develop their science case for the Lunar phase. In addition to the large network data collection once on the moon, individual teams code will be activated to collect their desired data. The data will be made available on a public dashboard for future science and analysis, allowing for even greater community science access and opportunity. GLEE is also a Space Grant student run and student designed mission. Students are gaining experience in project management, systems engineering, hardware and software development, and community relations.