MAGNETIC GRADIOMETRY AND ONGOING MODELING EFFORTS FOR THE *LUNAR VERTEX* MISSION.
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The first Payloads and Research Investigations on the Surface of the Moon (PRISM1) delivery targets the Reiner Gamma (RG) swirl and magnetic anomaly [1]. To characterize the magnetic anomaly source and study the potential connection of the associated "mini-magnetosphere" to albedo variations within the swirl, the *Lunar Vertex* (LVx) investigation [2, 3] will carry an array of vector magnetometers on the lander (VML) and an array of vector magnetometers on the rover (VMR). Both instruments were assembled and calibrated at the Johns Hopkins University Applied Physics Laboratory (APL). Measurements during descent recorded by VML and during surface operations by both VML and VMR will characterize the spatial and temporal variation of magnetic fields across the RG swirl (Fig. 1).

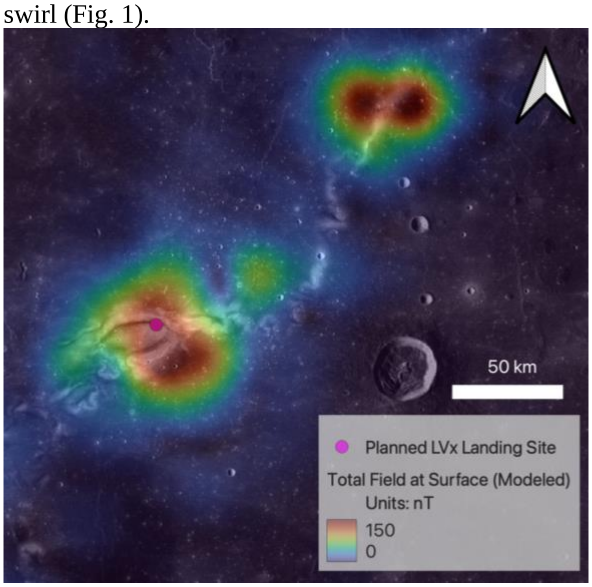

Fig. 1. *Total field modeled at the lunar surface above the Reiner Gamma magnetic anomaly [4], overlayed upon on an LROC WAC monochrome mosaic (100mpp, I/F reflectance image is stretched 0.0245 to 0.0735).*

Using a novel approach in mitigating magnetic field contamination from the lander and rover, VML and VMR observations will place new bounds on the orientation, strength, and depth of the RG magnetic anomaly source. This will provide insight into the formation mechanism of the magnetic anomaly and constrain the formation timeline by incorporating the geologic context of the region. Measuring small-scale variations in the surface magnetic field is also key for understanding the relationship between the magnetic anomaly and the optical swirl pattern [4]. In preparation for the upcoming LVx flight and operations in 2024, we use synthetic data and laboratory data incorporating magnetic sources to determine the accuracy and precision of the VML and VMR gradiometry technique.

Magnetic Gradiometry: VML is comprised of a tetrahedral array of four commercial fluxgate magnetometers mounted on the bottom of a 0.5-meter mast, with a science-grade dual-ring core fluxgate magnetometer mounted at the top of the mast. VML will be located at the top of the Intuitive Machines (IM) Nova-C lander. VMR is comprised of a tetrahedral array of four commercial fluxgate sensors mounted on a 0.2-meter mast, located on the top deck of the Lunar Outpost-provided rover. The tetrahedral array of both VML and VMR is composed of Bartington Mag566 sensors, which are used in a novel form of magnetic gradiometry [5, 6].

Gradiometry Algorithm Performance: The algorithm developed using the novel LVx magnetic gradiometry technique is referred to as the tetrahedral correction algorithm and been validated for a single dipole source using both synthetic data and experimental data [6]. The tetrahedral correction algorithm is capable of identifying and removing noise from a single dipole source with <5% residual errors. New work explores algorithm performance for noise removal of overlapping dipole sources, using synthetic data to simulate two thrusters firing simultaneously on a spacecraft. Initial results indicate that an iterative approach to removing overlapping noise sources is moderately effective, with ongoing efforts to quantify algorithm performance using laboratory data.

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