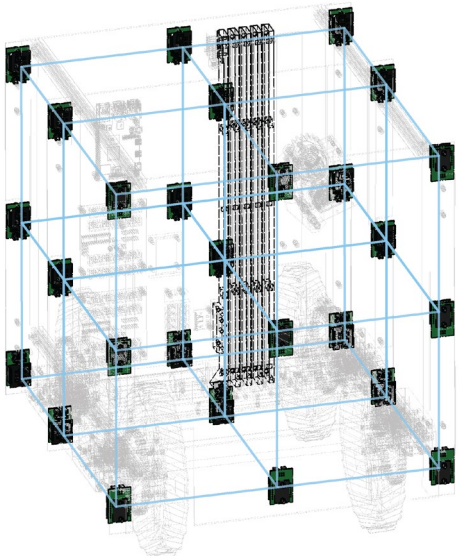
Lihn, Chi - Rover Concept for Exploring Lunar and Martian Crustal Magnetic Fields. S. D. Lihn[1] and P. J. Chi[2], [1]Edison Academy Magnet School, [2]University of California, Los Angeles.

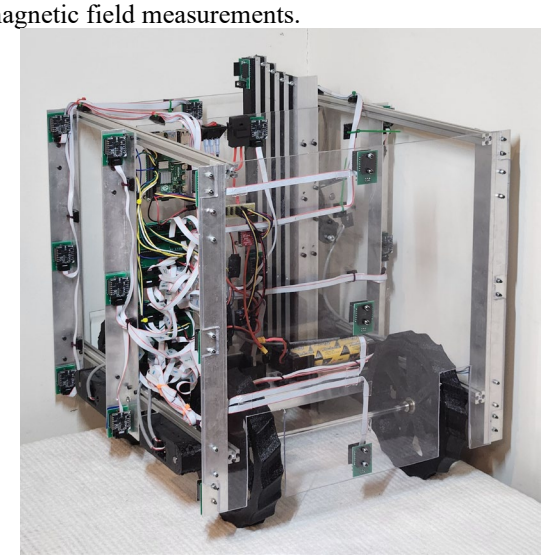
Introduction: The Moon and Mars have strong regional crustal magnetic fields as shown by the observations of orbiting spacecraft. These crustal magnetic fields indicate that a core dynamo was present in the past, and it is believed that rocks formed from cooling lava retain a memory of the strength and orientation of the magnetic field that existed during their solidification. However, a major hurdle in understanding the crustal magnetic field structure is the low spatial resolution limited by the altitude of the orbiting spacecraft. Rovers are well suited for exploring the detailed structure of the crustal magnetic fields, but they also require that the rover's own magnetic interference be removed from the raw sensor measurements.

Design: We designed a rover dedicated to measuring the detailed spatial distribution of the surface magnetic field. The design is scalable so that the rover can be made lightweight to meet the payload requirements for planetary missions. The rover is equipped with an array of magnetic sensors mounted in a 3×3×3 rectangular grid. This aims to allow data post-processing that will differentiate the magnetic fields of the rovers' own components from the ambient magnetic field being studied. Another magnetic sensor is placed on top of an extendable arm to provide additional measurements to verify the ambient magnetic field inferred from grid-point measurements. Additionally, rover components are selected to minimize the rover's own magnetic emissions, as not to saturate the sensor array and cause irremovable interference.



Sensor Configuration: The sensor grid aims to aid the examination of rover magnetic fields that can vary with operation modes and the chosen materials. The rectangular grid allows for sensors to be disabled to emulate different sensor configurations that could be used on future missions. The methodology for deducing the ambient magnetic field will build upon the two-sensor gradiometer technique used in past spacecraft missions [2, 3] and extend the tetrahedral magnetometer array as designed in the upcoming Lunar Vertex rover [1].

Hardware: The rover consists of four wheels, a Raspberry Pi single-board computer, sensor and motor control circuitry, and a chassis that holds the magnetometers in a rectangular array. The extendable arm has a magnetic sensor mounted to it and can be raised to three times the height of the rover. In the prototype of the rover, commercially available PNI RM3100 three-axis magnetometers are used for magnetic field measurements.



The test results from the rover will validate the viability and necessity of these design features. This will provide a useful reference for future planetary surface missions with rover-based experiments that measure crustal magnetic fields.

References:

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