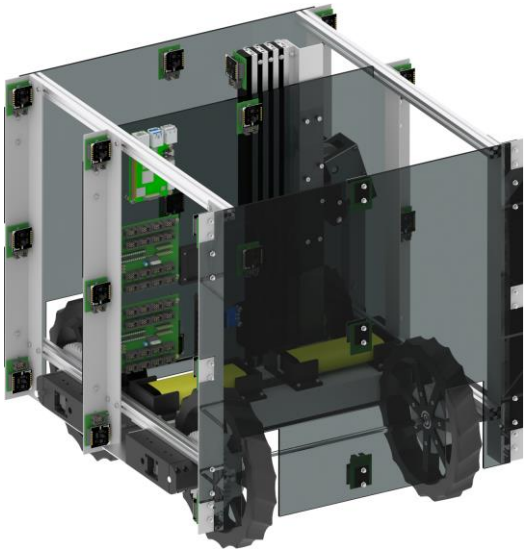
Compact Rover for Exploring Lunar and Martian Crustal Magnetic Fields. Samuel D. Lihn[1] and Peter J. Chi[2], [1]Middesex County Academy for Science, Mathematics, & Engineering Technologies, [2]University of California, Los Angeles

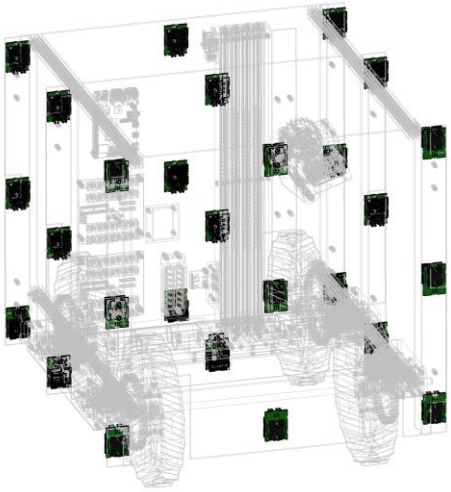
Introduction: The Moon and Mars have strong regional crustal magnetic fields as shown by the observations of orbiting spacecraft. These crustal magnetic fields indicate that a core dynamo was present in the past, and it is believed that rocks formed from cooling lava retain a memory of the strength and 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 present a technical challenge due to the necessity that sources of magnetic interference from the rover be removed from the measurements.

Design Goals: We designed a rover dedicated to measuring the detailed spatial distribution of the surface magnetic field. The rover was designed to be inexpensive and compact so many can be deployed to survey a large area.

The rover is equipped with an array of magnetic sensors mounted in a rectangular grid that aims to differentiate the rover components' own magnetic fields from the ambient magnetic field through data-model comparisons. Another magnetic sensor is placed on top of an extendable arm to provide additional measurements for verifying the ambient magnetic field inferred from grid-point measurements. Additionally, materials for the rover parts are selected to minimize the rover's own magnetic emissions, as not to interfere with the measurements of the sensor array.



Design: The rover consists of four wheels, a Raspberry Pi single-board computer, control circuitry, and a chassis that holds the magnetometers in a rectangular array. In the prototype of the rover, commercial small-scale microelectromechanical systems (MEMS) magnetometers are used for magnetic field measurements. These sensors are arranged in grid to simplify the data analysis for removing the rover's own sources of magnetic interference.



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.