

Title:

Future Exploration of the South Pole as Enabled by the Lunar Reconnaissance Orbiter

Authors:

Emerson, Sam, Julie, Mark, Brad, Philipp

Main Text:

The Lunar Reconnaissance Orbiter (LRO) launched in 2009 to collect the dataset required for future surface missions and to answer key questions about the lunar surface environment. In the first seven years of operations, the Lunar Reconnaissance Orbiter Camera (LROC) acquired over a million images of the lunar surface and collected key stereo observations for the production of meter-scale digital terrain models. Due to the configuration of the LRO orbit, LROC and the other onboard instruments have the opportunity to acquire observations at or near the poles every two hours. The lunar south polar region is an area of interest for future surface missions due to the benign thermal environment and areas of near-continuous illumination. These persistently illuminated regions are also adjacent to permanently shadowed areas (e.g. floors of craters and local depressions) that are of interest to both scientists and engineers prospecting for cold-trapped volatiles on or near the surface for future in situ resource utilization.

Using a terramechanics model based on surface properties derived during the Apollo and Luna missions, we evaluated the accessibility of different science targets and the optimal traverse paths for a given set of waypoints. Assuming a rover that relies primarily on solar power, we identified a traverse that would keep the rover illuminated for 94.43% of the year between 1 January 2021 and 31 December 2021. Throughout this year-long period, the longest eclipse endured by the rover would last only 101 hours and the rover would move a total of 22.11 km with an average speed of 2.5 m/hr (max speed=30 m/hr). During this time the rover would be able to explore a variety of targets along the connecting ridge between Shackleton and de Gerlache craters. In addition to the southern polar regions, we are also examining traverses around other key exploration sites such as Marius Hills, Ina-D, Rima Parry, and the Mairan Domes in efforts to aid future mission planners and assess the requirements for future roving prospectors (e.g., maximum speed, maximum slope, etc.).