TRAVERSE PLANNING USING LUNAR RECONNAISSANCE ORBITER NARROW ANGLE CAMERA DIGITAL ELEVATION MODELS. E. J. Speyerer[1], S. J. Lawrence[1], J. D. Stopar[1], K. N. Burns[1], and M. S. Robinson[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ (espeyerer@ser.asu.edu).

Introduction: Recent lunar missions provide important new geologic and topographic datasets for the Moon. To supply precise measurements, execute preparatory investigations, and collect ground-truth samples for these remotely sensed datasets, future precursor landers and rovers are required. One of the primary goals of the Lunar Reconnaissance Orbiter (LRO) is to deliver datasets that can be used to plan future missions to the lunar surface including landers and rovers. Digital elevations models (DEMs) derived from select LRO Narrow Angle Camera (NAC) stereo image pairs provide surface topography, slopes, and roughness at down to the 2 m scale (depending on the resolution of the input images) [1,2]. By considering multiple datasets, including those derived from the NAC DEMs, we determine least energy traverse maps of key exploration sites that can aid planning future rover mission.

Traverse Planning Tool: To plan traverses investigating key exploration sites, the raster DEM is converted into a network of equally spaced nodes. The spacing between nodes can be as fine as the original raster DEM, or several times larger depending on the size of the region, required accuracy of the traverse, and computational constraints. Each node connects to its six neighboring nodes to form a graph structure. The energy required, or cost, to traverse from one node to a neighboring node is dependent on an array of variables derived from the NAC DEM, the model rover, and other data sources:

- Down track slope (NAC DEM)
- Cross track slope (NAC DEM)
- Terrain ruggedness (NAC DEM)
- Solar panel orientation (NAC DEM, model rover)
- Rolling resistance (a model rover)
- Turning capabilities (a model rover)

Using Dijkstra's algorithm [3], the lowest energy traverse paths from an initial node to all the nodes in the network are calculated. This framework is flexible over a broad scale of terrain types and scalable from localized regions to large exploration sites.

Energy and Traverse Maps: Maps derived from these calculations show the energy needed to traverse from the initial node to all the other nodes in the network (Figure 1). In addition to identifying relative energy to traverse from one site to another, these maps also identify areas that are not accessible to the model rover given a pre-defined set of constraints such as the maximum traversable slope.

When using Dijkstra's algorithm, the lowest cost path to travel to each node in the network is also stored. By selecting any traversable point on the map, the lowest cost path from the initial node is identified.

Tool for Future Exploration: A traverse planning tool such as the one employed here is key for any future lunar mission planning activities. These maps identify least energy traverse paths, as well as delimit traversable and inaccessible areas around each exploration site. We can also use this tool to identify the required capabilities and operational characteristics a future prospecting rover would need in order to reach key targets of scientific interest at a specific site. Future development will focus on adding other datasets and cost parameters such as boulder populations derived from Diviner measurements and LOLA-derived surface roughness.

References: [1] Robinson et al. (2010) Space. Sci. Rev. [2] Burns et al. (2012) ISPRS [3] Dijkstra (1959) Numerische Mathematik.

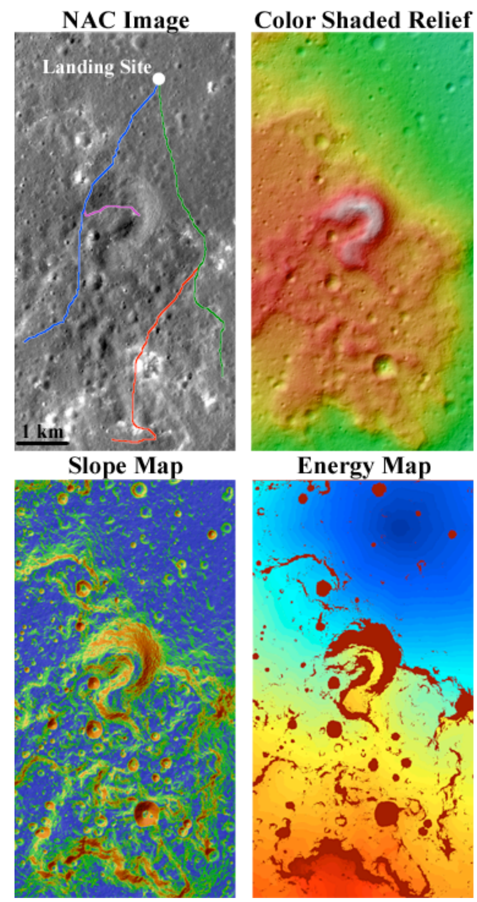

Figure 1- NAC image (M111965782L/R) with potential low energy rover traverses in the Marius Hills region with corresponding shaded relief, slope, and energy map derived from a NAC DEM.