INFORMED LINE-OF-SIGHT COMMUNICATIONS ON THE LUNAR SURFACE USING LRO NAC DEMs. Prasun Mahanti[1] , Mark S. Robinson[1], Aaron Boyd[1], Emerson Speyrer[1] ,[1]Lunar Reconnaissance Orbiter Camera Science Operations Center, Arizona State University, Tempe, AZ. (pmahanti@asu.edu)

Introduction: Short and long range line-of-sight communication on the lunar surface is of vital importance for both robotic and human extra-vehicular activity (EVA) [1,2,3]. While line-of-sight based data acquisition and transmission techniques remain the most potent form of communication between assets on the lunar surface, it also presents operational limitations [2]. Astronauts or robotic landers must have either the main lunar module (LM) or another rover in their line-of-sight to maintain com-munication for imaging or any other form of data acquisition. A-priori information mitigate this limitation, e.g. for the efficient placement of transmission modules or knowing the elevation required by an imaging device to be able to see required targets. Shadow maps can be used to acquire this information [2] to estimate LM/EVA line-of-sight for pre-mission planning and real-time EVA. Detailed elevation information can be used to form even better information maps and possible decision strategies well in advance before the actual mission as well as for real-time decision making. For example, in the NASA Mars Exploration Rover project [4] visibility analysis was done prior to landing to find how far the rover actually might see from the surface. Digital terrain models (DEMs) made from the Lunar Reconnaissance Orbiter Narrow Angle Camera (LRO NAC) stereo images offer high resolution elevation information with pixel scales down 2 meters. In this work we show some examples of how NAC DEMs can be utilized for exploration planning.

Viewsheds and maximum visibility analysis: A viewshed is a location (geographic/cell/pixel) specific visible area. Viewshed analysis uses the elevation

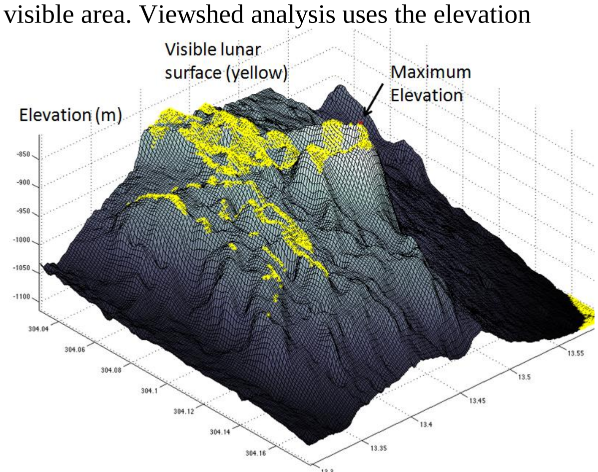

Figure 1: Viewshed at maximum elevation

information to determine interlocation visual connectivity based on observer and target positions. From the NAC DEMs, a rigorous viewshed analysis can be done; an example of such an analysis was performed for a DEM obtained at the Marius Hills (NAC images M111958993 and M111965782) showing (Figure1) the terrain area visible from the highest elevation point with the observer height set for 2 meters. A key result is that only a small percentage of the total surface area was 'visible' from this highest point. Similar analysis was done for all the cells for the DEM, and for each cell the corresponding viewshed area was recorded as a percentage of the total DEM area. We call the resulting matrix the maximum visibility map (Figure 2). Regions of high visibility are immediately evident from the map, with about 30% of the total terrain visible specific points. Also, smoother parts of the terrain show higher average levels of percentage visibility.

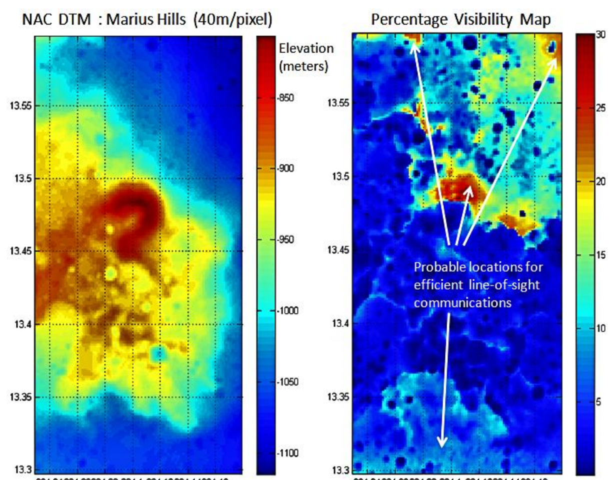

Figure 2 : DEM & maximum visibily map

Conclusions: The resolution of the NAC DEMs is highly adventagious for lunar viewshed analysis. Line-of-sight visibility conditions can be readily assessed with high accuracy. Multiple viewshed analysis results can be combined to generate more informative results, providing the basis for future lunar exploration planning.

References: [1] Kraus H. & Rosenblum I (1970) NASA-CR-110487[2] Hanson T. Markley. R. (1993) GLOBECOM'93 IEEE 929-933,2.[3] Cooper B.L. et al (2005) J. earth Syst. Sci., 815–822. [4] URL:http: // webgis.wr.usgs.gov/mer/viewshed_analysis.htm (2009)