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SENSOR LEVELING AND DISTANCE MATCHING METHODOLOGIES FOR LUNAR ROVERS

Abstract

While previous generations of lunar rovers of the Soviet Lunokhod and Chinese Yutu rovers focused on the general reconnaissance of the lunar surface, such as lunar terrain and horizon mapping. The next generation of lunar rovers will focus on detailed surface investigations that will try to identify the lunar soil's physical and chemical properties.

Sensors investigating the lunar surface will likely be installed either directly vertically or in parallel to the lunar surface. The vertical sensors will predominantly look at the particle disposition, conduct multispectral analysis, and make measurements at the micro level. The horizontal sensors will look at the levitating properties of the lunar regolith, first described as the "horizon glow" and later identified to be from electrostatic forces among the dust particles.

These observations may not allow for the direct contact of the sensor suite with the ground surface, as it may disturb the objective area. At the same time, these sensors will require exact distancing from the object of study when using high-fidelity instruments with short focal points, or to observe phenomena that differ from its distance from the surface level. This exact distance matching is also imperative to identify the accurate size of the images being captured. Traditional lunar rovers are not well equipped to provide these requirements as the lunar wheels will sink into the soft regolith layer, and nonuniform terrain will twist the balance of the rover chassis that house the sensors.

This study looks at a few methods that may provide a solution to the leveling and distance-matching problem posed to the next generation of lunar rovers. The first type of solution involves deployable physical antennas with pressure sensors equipped on the end, angled away from the sensor's field of view so as to not disturb the area being observed. The second type of solution involves a Michelson interferometer that can detect both angular and distance variation of the target within a certain range with great accuracy.

This paper will look at the strengths and weaknesses of both methods when applied to the lunar surface domain. The softness of the lunar regolith, nonuniform properties of regolith to depth, dispersion of laser light at the surface, and minor discrepancies to the sensors detecting the level and distance to the payload sensor making the observation, all pose challenges to be solved by future research.