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LOONY: LASER RANGING FROM THE MOON FOR ULTRA-HIGH ACCURACY TRACKING OF SATELLITES AND DEBRIS IN LUNAR ORBIT

Abstract

The Moon is fast becoming mankind's first off-world planetary outpost. In the coming decades, cross-sector activity will increase both on the surface and in lunar, or selenocentric, orbit. Plans are already in motion for lunar navigation and communication services delivered from orbit, for example. Back on earth, we are currently wrestling with the issues related to increased orbital activity in the form of space debris, space traffic management, and collision avoidance. In lunar orbit, the altitudes of orbiting satellites will be in the 10s of kilometres instead of 100s or 1000s, and hence the orbital periods will be measured in just a couple of hours. Therefore the available orbital space, and hence useful capacity, is greatly reduced. On top of that, there is no atmosphere to aid the safe disposal of orbital assets.

These factors combined make for a compelling case for a lunar space surveillance and tracking (SST) system, for which precision will be key. On earth, satellite laser ranging (SLR) is our most accurate tool for orbit determination, and so this is the technology we have embraced in this study.

This study presents LOONY; a Lunar Optical Orbit Navigation sYstem, our concept for a satellite laser ranging station on the Moon including optical tracking. This paper describes the impact that the low orbits and lack of atmosphere have on the equations on optical systems requirements, and a proposed station concept is presented. Consideration is given to the practical and technical feasibility of deploying and operating such a station, a system block diagram is presented, and required technology development is discussed.

Additional effort is put into explaining the other benefits such a system could bring aside from collision avoidance, for example, providing orbital navigation systems with a reference position (SLR provides this for GNSS on earth), and like the geodetic science on earth, a lunar SLR system could provide great insight into the tidal deformation of the Moon and other related scientific endeavours.