A Proposal for Using Very Long Baseline Interferometer Observations to Improve Lunar Ephemerides

James Hilton*[1], Greg Hennesey[1], George Kaplan[2], and Valery Makarov[1]

[1]U.S. Naval Observatory – United States
[2]contractor to U.S. Naval Observatory – United States

Abstract

Future lunar activity will require the installation of a number of radio transmitters on the lunar surface. These transmitters present an opportunity to re-establish the use of Very Long Baseline Interferometry (VLBI) in the construction of lunar ephemerides. Precision lunar ephemerides for the past fifty years have been constructed using solely lunar laser ranging (LLR), because it is at least an order of magnitude more accurate than any other currently available data type. LLR provides only a single dimension, range. Reliance on range alone results in large covariance values to some adjustable parameters in the ephemeris solution. Fifty years ago relative VLBI observations using the Apollo Lunar Surface Experiments Packages (ALSEP) demonstrated that it can be used to provide superior lunar libration results to those from LLR alone (King 1975, PhD thesis, MIT). It should also be able to give a better determination of the tidal and thermal deformations of the lunar geoid. These improvements arise from VLBI's ability to provide three parameters complimentary to LLR ranges: X and Y plane-of-sky positions and radial velocity. Past proposals to establish lunar VLBI beacons were made for just this reason. The reduction process for analyzing near-field narrow-band observations, such as those from radio transmitters on the lunar surface, is well developed. The intent of this presentation is to investigate the viability of using the existing VLBI infrastructure with future lunar radio transmitters.

*Speaker