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Improving on the high latitude topography of the moon via precise timing of the Lunar Prospector radio occultations

S. W. Asmar (Dept. of Earth & Space Sciences, UCLA & JPL, Caltech), G. Schubert (Dept. of Earth & Space Sciences, Inst. of Geophysics & Planetary Physics, UCLA), A. S. Konopliv (JPL Caltech), W. Moore (Dept. of Earth & Space Sciences, UCLA)

Abstract

The topography dataset, when combined with the gravitational field dataset, leads to valuable information about the internal structure of the moon. The topography data obtained from the Clementine lidar measurements, represented in spherical harmonics to 90th degree, are of good quality but lacking in the high latitude regions due to the geometry of that mission. The more recent Lunar Prospector mission did not carry instrumentation for direct measurement of the topography. The spacecraft, however, was routinely occulted from the view of the ground stations by the moon itself. Although the occultations disrupted the telemetry and Doppler data transmission, they provided a new data type that would improve on the topography in the polar regions. The precise timing of the loss of the radio signal and it re-appearance on the other side of the moon was achieved to an accuracy of about one hundredth second. The time is multiplied by the orbital velocity of the spacecraft to produce the length of the chord and polar radius of the moon to an expected accuracy of tens of meters. When a sufficient number of the occultation data are processed, they can be used to generate a topographic field of the polar regions to supplement the existing dataset obtain from the Clementine mission. This paper will present the data from the three campaigns of occultation data acquisitions that were implemented in 1998. It will also describe the modeling and removal of the diffraction pattern effect generated due to the limb of the moon behaving as a sharp-edge obstacle to the incident radio signal. The paper will describe the conversation of the corrected data to lunar radii that can be incorporated in the topography field.