Geophysical Research Abstracts
Vol. 12, EGU2010-10253, 2010
EGU General Assembly 2010

Precision Orbit Determination for the Lunar Reconnaissance Orbiter

F.G. Lemoine (1), E. Mazarico (1,2), D.D. Rowlands (1), M.H. Torrence (1,3), J.F. McGarry (1), G.A. Neumann (1), D. Mao (1,4), D.E. Smith (5,6), and M.T. Zuber (6)

(1) NASA Goddard Space Flight Center, Greenbelt, Maryland, United States , (2) Oak Ridge Associated Universities/NPP @ NASA GSFC, Greenbelt, Maryland, United States, (3) Stinger Ghaffarian Technologies, Greenbelt, Maryland, United States, (4) Sigma Space Corp., Lanham, Maryland, United States, (5) NASA Goddard Space Flight Center (Emeritus), Greenbelt, Maryland, United States, (6) Dept. of Earth, Atmospheric, and Planetary Sciences, Cambridge, Massachusetts, United States

The Lunar Reconnaissance Orbiter (LRO) spacecraft was launched on June 18, 2009. In mid-September 2009, the spacecraft orbit was changed from its commissioning orbit (30 x 216 km polar) to a quasi-frozen polar orbit with an average altitude of 50km (+-15km). One of the goals of the LRO mission is to develop a new lunar reference frame to facilitate future exploration. Precision Orbit Determination is used to achieve the accuracy requirements, and to precisely geolocate the high-resolution datasets obtained by the LRO instruments. In addition to the tracking data most commonly used to determine spacecraft orbits in planetary missions (radiometric Range and Doppler), LRO benefits from two other types of orbital constraints, both enabled by the Lunar Orbiter Laser Altimeter (LOLA) instrument. The altimetric data collected as the instrument's primary purpose can be used to derive constraints on the orbit geometry at the times of laser groundtrack intersections (crossovers). The multi-beam configuration and high firing-rate of LOLA further improves the strength of these crossovers, compared to what was possible with the MOLA instrument onboard Mars Global Surveyor (MGS). Furthermore, one-way laser ranges (LR) between Earth International Laser Ranging Service (ILRS) stations and the spacecraft are made possible by the addition of a small telescope mounted on the spacecraft high-gain antenna. The photons received from Earth are transmitted to one LOLA detector by a fiber optics bundle. Thanks to the accuracy of the LOLA timing system, the precision of 5-s LR normal points is below 10cm.

We present the first results of the Precision Orbit Determination (POD) of LRO through the commissioning and nominal phases of the mission. Orbit quality is discussed, and various gravity fields are evaluated with the new (independent) LRO radio tracking data. The altimetric crossovers are used as an independent data type to evaluate the quality of the orbits. The contribution of the LR data is assessed. Multi-arc solutions over entire months are presented, which allow to strengthen the LR data because fewer clock-related parameters need to be adjusted. Finally, a preliminary 1-month solution with altimetric crossover constraints is evaluated and discussed