Geophysical Research Abstracts
Vol. 16, EGU2014-7019-1, 2014
EGU General Assembly 2014

GRAIL Gravity Field Determination Using the Celestial Mechanics Approach

Daniel Arnold, Adrian Jäggi, Stefano Bertone, Gerhard Beutler, Ulrich Meyer, Leos Mervart, and Heike Bock
Astronomical Institute, University of Bern, Switzerland (daniel.arnold@aiub.unibe.ch)

To determine the gravity field of the Moon, the NASA mission GRAIL (Gravity Recovery and Interior Laboratory) inherits its concept from the GRACE (Gravity Recovery and Climate Experiment) mission. The use of inter-satellite Ka-band range-rate (KBRR) observations enables data acquisition even when the spacecraft are not tracked from the Earth. The data allows for a highly accurate estimation of the lunar gravity field on both sides of the Moon, which is crucial to improve the understanding of its internal structure and thermal evolution.

In this presentation we discuss GRAIL-based lunar gravity fields generated with the Celestial Mechanics Approach. KBRR observations and position data (GNI1B products) are used to solve for the lunar gravity field parameters in a generalized orbit determination problem. Apart from normalized spherical harmonic coefficients up to degrees n $\leq$ 200, also arc- and satellite-specific parameters, like initial state vectors and pseudo-stochastic pulses, are set up as common parameters for all measurement types. The latter shall compensate for imperfect models of non-gravitational accelerations, e.g., caused by solar radiation pressure. In addition, especially for the data of the primary mission phase, it is essential to estimate time bias parameters for the KBRR observations.

We compare our results from the nominal and from the extended mission phase with the official Level 2 gravity field models first released in October 2013. Our results demonstrate that the lunar gravity field can be recovered with a high quality by adapting the Celestial Mechanics Approach, even when using pre-GRAIL or pre-SELENE gravity field models as a priori fields and when replacing sophisticated models of non-gravitational accelerations by appropriately spaced and constrained pseudo-stochastic pulses.