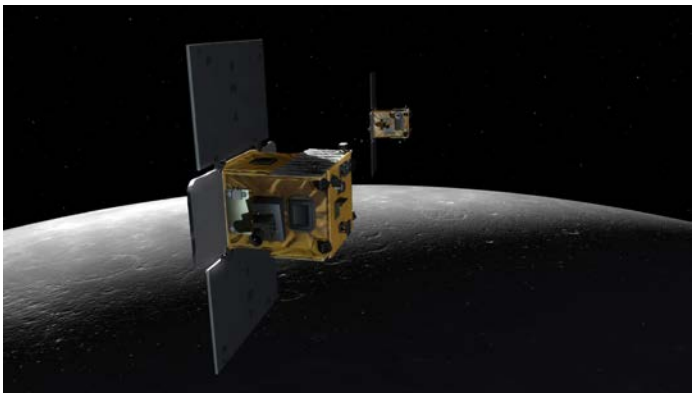

UNIVERSITÄT BERN

Universität Bern

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Bachelor/Master Thesis

Dynamic Orbit Modeling of the Lunar Orbiter GRAIL

MOTIVATION

NASA's lunar mission GRAIL was launched on September 10, 2011 into a lunar orbit of 55 km and 32 km altitude for the primary and extended mission phase, respectively, and ended with a controlled crash on the lunar surface on December 17, 2012. It consisted of two satellites following each other on the same orbital trajectory. Each satellite was equipped with antennas for Doppler tracking from the Earth and inter-satellite K-Band ranging with micrometer precision to map the lunar gravity field with unprecedented accuracy and spatial resolution. First GRAIL orbit and gravity field solutions were computed at the Astronomical Institute of the University of Bern (AIUB) in the frame of the project "A Bernese Gravity Field Model of the Moon" funded by the Swiss National Science Foundation. Non-gravitational accelerations acting on the GRAIL satellites are currently modeled purely empirically by estimating them from the tracking data. No explicit models were taken into account for direct solar radiation pressure and lunar albedo radiation pressure acting on the satellites.

DESCRIPTION

- As a first step of this Master thesis empirical parameters tailored to the non-gravitational accelerations acting on the GRAIL satellites shall be incorporated and validated within the Bernese GNSS Software. Use can be made of existing procedures for automated GRAIL orbit determination.
- In a further step of sophistication macro-models (description of the satellite by a number of flat planes characterized by their area, orientation, and optical properties) shall be used for a refined modeling of direct solar radiation pressure and lunar albedo. Several parametrizations may be tested (estimation of scale factors, additional empirical parameters) and an optimal non-gravitational force modeling shall be established for GRAIL orbit determination using position and K-Band observations.

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