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Lunar gravity field recovery: GRAIL simulation studies

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The NASA mission GRAIL (Gravity Recovery and Interior Laboratory) makes use of low-low Satellite-to-Satellite Tracking (ll-SST) between the two spacecraft GRAIL-A and GRAIL-B to determine a high-resolution gravity field solution of the Moon. The mission concept is inherited from the GRACE (Gravity Recovery and Climate Experiment) project, a space gravimetry mission mapping the terrestrial gravity field.
Since the Moon is in synchronous rotation with the Earth, direct (radio) tracking of the satellites on the farside is impossible, but GRAIL provides global coverage of inter-satellite tracking data. Furthermore, ll-SST observations are much more sensitive to gravitational features than ground-based orbit tracking. Therefore, compared to previous missions, GRAIL enables a more accurate estimation of the lunar gravity field, with a much higher spectral and spatial resolution. The accurate knowledge of the lunar nearside and farside gravity is essential to improve the understanding of the Moon's interior structure and its thermal evolution.
We conducted a series of sensitivity studies based on simulated orbit information (positions) and ll-SST measurements (ranges, range rates, range accelerations). Observations are simulated on the nearside as well as on the farside (1) during the time span of the GRAIL science phase, (2) for different orbit altitudes and varying separation distances, (3) for different orbit/ll-SST noise levels. Based on the simulated observations the spherical harmonic coefficients, which represent the lunar gravity field, are estimated using an integral equation approach. Observation simulation and parameter estimation is accomplished using the GROOPS (Gravity Recovery Object Orientated Programming System) software package.