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Simulation study for the determination of the lunar gravity field in the framework of the German LEO mission

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All currently available lunar gravity field models suffer from non-availability of tracking data on the far side of the moon. One of the best models is LP150Q derived from S-band tracking data of the US missions Clementine (1994) and Lunar Prospector (1998) and developed up to degree and order 150 (36 km half wavelength). This model shows relatively small selenoid height errors of a few meters for the near side, but a factor of 10 larger errors on the far side. To improve the situation the Japanese SELENE mission (launch in 2007) will perform 4-way Doppler measurements between a relay satellite and a low altitude main orbiter, allowing for the first time to derive the selenoid with a homogeneous one order of magnitude accuracy improvement up to degree and order 30 (Matsumoto et al, 2007) compared to previous models and an overall improvement up to degree and order 75.

The German LEO (Lunar Explorations Orbiter) mission is still in a phase 0 planning stage where also a gravity field determination experiment is foreseen. This will be based on a satellite pair in identical orbits and separated by some tens of kilometres performing highly precise micrometer accuracy range and range-rate low-low satellite to satellite tracking (SST) observations in Ku- and S-band. At least one of the two orbiters will be equipped with a micro-gradiometer MIGIM (Micro-Gradiometer Instrument for the Moon), thus combining very high spatial resolution (short wave length) measurements of the MIGIM with the long wavelength LIST (Lunar Inter-

Satellite Tracking) experiment in an optimal manner. Additionally it is foreseen to determine the two LEO orbits from analysis of microwave tracking from Earth whenever the satellites are in view.

Both the concept of Satellite Gradiometry (SGG) using MIGIM and SST have advantages and disadvantages which directly influence the design of the LEO mission. In order to support the industry, simulations have been initiated which cover different parameters such as SGG and SST measurement accuracy, satellite altitude or background model errors. The presentation will show some first results which includes a performance analysis of the MIGIM and the complementarities of orbital tracking, low-low SST and SGG.