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Lunar gravity field coefficients from simulated and real tracking data to LRO

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The lunar gravity field is essential for understanding the structure and the thermal evolution of the Moon. Typically, the gravity field of a body is inferred from tracking data to orbiting satellites, since the satellite's orbit is influenced by the gravity field. Due to the fact that the Moon is in the state of synchronous rotation with the Earth, direct tracking of a satellite over the farside is impossible. NASA's Lunar Reconnaissance Orbiter (LRO), launched in 2009, is equipped with various instruments whose purpose is to prepare for save robotic returns to the Moon. To geolocate LRO, the spacecraft is tracked by means of radiometric techniques (ranges, range rates, angles) and optical laser (ranges). We conducted a series of closed-loop simulations to investigate the quality of gravity field coefficients estimated from (1) laser ranges only, (2) range rates only, and (3) laser ranges and range rates. Real-data characteristics such as the number of observations, their spatial distribution on the lunar surface, and the present noise level were used for observation generation. Further, we started to analyze real laser ranges to LRO. Precise orbit determination by means of laser ranges alone is difficult due to sparse observations. The best results are expected once when laser ranges and range rates are combined.