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SLR signature effect for Galileo with a focus on satellites launched into incorrect orbital planes

Satellite Laser Ranging (SLR) observations to GNSS satellites allow for an independent validation of GNSS orbits, including the identification of orbit modeling deficiencies of newly-established and currently being deployed GNSS systems, such as Galileo. The current SLR observations, despite their exceptionally high precision, are affected by some systematic effects related to the detection mode and detector type used at SLR stations. We analyze the satellite signature effect for Galileo satellites with a distinction between SLR stations equipped with different detector types: controlled single-photon avalanche diodes (C-SPAD), photo-multiplier tubes (PMT), and micro-channel plates (MCP). This study will identify whether the inclination and orientation of a planar retroreflector onboard Galileo satellites have any impact on the SLR residuals. In Orbit Validation (IOV) and Full Operational Capability (FOC) Galileo satellites were equipped with arrays consisting of a different number of corner cubes. The difference between IOV, FOC, and first FOC satellites launched into incorrect orbital planes will also be addressed. Finally, we will analyze the SLR residuals to Galileo satellites in incorrect, highly-eccentric orbits with a focus on orbit quality, the SLR signature effect, and the orbit modelling issues, as the Galileo satellites have not been designed for operating in highly-eccentric orbits with variable angular and linear velocities with respect to the ground observer.