Detecting Space Debris with the New Satellite Laser Ranging System at Metsähovi

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We study the ability of the forthcoming satellite-laser-ranging (SLR) facility at the Metsähovi Geodetic Fundamental Station to observe space debris in low-Earth orbits (LEO). The monitoring of the growing space debris population requires reliable acquisition of observational data, to support the development and validation of population models and to build and maintain catalogues of orbital elements. Debris on LEO have so far been typically tracked by radar methods and SLR has only recently been considered as a debris-tracking technique. The new facility in Metsähovi has been designed to be upgradeable beyond the standard geodetic SLR operation mode and our main goal is to determine the specifications of a debris-tracking capable Metsähovi SLR system.

We work on the radar link budget and a calculation tool to find out whether the system would be capable of detecting space debris in LEO. How small can a dark object unequipped with retroreflectors be, and how high can its orbit be located, that it could be successfully ranged with an SLR system originally engineered for other purposes? The preliminary results obtained are promising. A dark object with an optical cross-section of the order of 1 meter could be detected on orbits up to about 500 km under normal sky conditions, and up to 600 km under best sky conditions. In order to increase this range, we consider using the SLR system with its built-in, more powerful near-infrared light (1064 nm) instead of the regular green one (532 nm). In that case, a dark object with an optical cross-section of the order of 1 meter could be detected on orbits up to about 700 km under normal sky conditions, and up to 1000 km under best sky conditions. Although each SLR system is unique, the results provide valuable information of possible observing concepts for other SLR stations as well as to the global SSA efforts for space debris tracking.