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COMPACT GROUND STATION FOR SATELLITE LASER RANGING AND IDENTIFICATION

Abstract

Satellite Laser Ranging (SLR) is a key technology for keeping track of satellite positions and precisely determining their orbits around Earth. We are taking this technology one step further and have developed a laser-optical method, which allows for the identification of satellites. This tagging technology makes use of space qualified corner cube reflectors (CCRs) that alter the polarization state of retroreflected light. Such a passive 'number plating system' is operating independently of on-satellite energy sources, i.e. it allows for identification and tracking even if the satellite is malfunctioning. This technology can be especially useful for small satellites (CubeSats) that are often launched in clusters, have a high dead-on-arrival (DOA) rate and cannot easily be identified by existing space situational awareness (SSA) / space traffic management (STM) systems.

This method will be implemented in our research platform 'miniSLR®', an automated, small, autonomous and transportable SLR station. By incorporating many off-the-shelf components into a standardized station with only a 1.5 m by 2 m base area, availability and affordability are ensured. The design of the system allows for an operation with small servicing effort, enabling a placement even at remote locations. With the miniSLR® prototype having now reached the field-testing stage, we confidently demonstrated optical closed-loop tracking capability up to GNSS orbits and, in addition, have received laser return signals from several LEO satellites. With the integration of a new, highly repetitive laser source with sub-ns pulse duration in the next months, the precision is expected to be reduced to the mm range, based on calculations and experience from our previous SLR station.

Launching new satellites, especially constellations, requires better space traffic monitoring for collision avoidance. SLR can provide this essential mission support, but the necessary extension of the ground station network by using large observatories is expensive. A configuration of small SLR stations like the miniSLR® placed around the globe has the potential to extend the existing SLR network capacity at a fraction of the typical installation and operational costs of common, large SLR observatories.