A tool for simulating SLR residuals - Placement of backup retroreflectors for future satellite missions

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Defunct satellites or other space debris can start to rotate related to external or internal forces acting on the body. Future removal missions rely on a profound knowledge of the orbit and attitude of space objects. Utilizing different techniques (satellite laser ranging (SLR), space debris laser ranging, radar or light curves) rotational parameters can be measured.

The design and placement of additional (backup) CCRs on side faces of satellites was studied within the ESA activity “Retroreflector-based Attitude Detection System (RADS)”. The placement of small (e.g. commercial-off-the-shelf) CCRs on future satellite missions would allow accurate monitoring of such tumbling behavior e.g. within the ILRS even for stations without a space debris laser.

Using a modular approach, a simulation tool is introduced to simulate SLR residuals. Rotating satellites produce a distinct periodical residual pattern connected to the movement of the CCRs with respect to the center of mass of the satellite. Within the tool different parameters (satellite, orbit, CCR position and orientation, rotation period, rotation axis orientation, reference coordinate frame) can be arbitrarily adjusted, allowing to design and orient the CCRs according to specific needs or boundary conditions of the mission. A comparison of measured SLR datasets to satellites with known attitude was used to validate the simulation results of the tool.