Attitude determination of Galileo spacecraft using high resolution kHz SLR

Dr. Michael Steindorfer[1], Dr. Georg Kirchner[1], Ing. Franz Koidl[1], M. Sc. Peiyuan Wang[1], Dr.-Ing. Erik Schoenemann[2], Francisco Gonzalez[3]

[1]Space Research Institute, Austrian Academy of Sciences, Graz, Austria, [2]ESA/ESOC, Darmstadt, Germany, [3]ESA/ESTEC, Noordwijk, The Netherlands

The influence of different laser beam polarization states on satellite laser ranging accuracy was investigated for Galileo retroreflector panels. More than 1600 1-minute normal points were measured with varying pass geometries and laser beam incident angles. The polarization state was switched between along satellite track / across satellite track and circular polarization. No noticeable trend was found within the data proving the good manufacturing and clocking quality of the ESA panels.

Furthermore a spare Galileo retroreflector panel was mounted on a tripod 32 km outside of the SLR station Graz. The panel was tilted to achieve laser beam incident angles between 0° and approx. 18° while simultaneously doing distance measurements. Within the full-rate data for incident angles larger that approx. 10° it was possible to identify several fine structures corresponding to the different columns of retroreflectors within the panel. For a specific pass of Galileo-103 matching the incident angle of the ground-based measurements the same details were found within the data set. By doing a histogram analysis calculating the range distance between the returns from each of these retroreflector columns it was possible to verify the expected 11.4° incident angle on the panel to be 11.38°, indicating a 0.02° panel pointing accuracy for the panel and consequently the roll angle of the Galileo spacecraft. This test provides a way to validate the Galileo panel pointing accuracy and is only possible by analyzing the fine details of mm-accuracy kHz SLR data.