Bachelor /Master thesis at the Astronomical Institute

New methods for attitude determination of space debris

MOTIVATION

Ground-based passive attitude determination is useful in contingency scenarios (e.g. the investigation after the sudden loss of a satellite), for the preparation of Active Debris Removal (ARD), as well as for general purposes, like e.g. external torques estimation, calibration.

In 2015, the attitude of the defunct satellite ENVISAT was determined from Satellite Laser Ranging (SLR) data acquired by the multi-purpose 1-meter telescope of the Zimmerwald observatory. The outcomes of this study were the spin rate and the spin axis orientation, as well as their time evolution. This experimental method has now to be optimized and completed with light-curve observations before being applied to other targets for which data are currently acquired.

DESCRIPTION OF THE WORK

The work will first consider the processing of new SLR targets (ERS-1/2, Oicets, ADEOS-2, GLONASS, etc.) using the existing tool for SLR data processing and attitude extraction (spin rate and spin axis direction). After a deeper understanding of the used procedure, further work will be dedicated to the additional improvement of the basic algorithm. The candidate will investigate whether the approach used for SLR data can be also applied to process light curves of simple-shaped objects (such as box-wing satellites and cylindrical upper stages) in order to extract their attitude information. Eventually, the candidate will investigate the possibility of using the results obtained from the attitude determination for orbit improvement. Possibly, using the available information about the physical properties of the targets and the extracted attitude parameters as a function of time, the candidate will try to estimate the external torques affecting the attitude during the investigated period.

The work will provide insight into the methods to observe and characterize artificial satellites and space debris. In view of the ongoing ESA and EU Space Situational Awareness (SSA) programs, as well as the current scientific research in the space debris and SSA community, the acquired expertise will provide the candidate an ideal qualification.