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SPACE DEBRIS SYMPOSIUM (A6)
Measurements (1)

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EXTRACTION OF SPIN PERIODS OF SPACE DEBRIS FROM OPTICAL LIGHT CURVES

Abstract

The population of space debris increased drastically during the last years. These objects became a great threat for active satellites. Because the relative velocities between space debris and satellites are high, space debris objects may destroy active satellites through collisions. Furthermore, collisions involving massive objects produce large number of fragments leading to significantly growth of the space debris population.

The long term evolution of the debris population is essentially driven by such so-called catastrophic collisions. An effective remediation measure in order to stabilize the population in LEO is therefore the removal of large, massive space debris. To remove these objects, not only precise orbits, but also more detailed information about their attitude states will be required. One important property of an object targeted for removal is its spin period and spin axis orientation. If we observe a rotating object, the observer sees different surface areas of the object which leads to changes in the measured intensity. Such a time series of measured brightness is called a light curve. Rotating objects will produce periodic brightness variations with frequencies which are related to the spin periods.

Collecting, but also processing light curves is challenging due to several reasons. Light curves may be undersampled, low frequency components due to phase angle and atmospheric extinction changes may be present, and beat frequencies may occur when the rotation period is close to a multiple of the sampling period. Depending on the method which is used to extract frequencies, also method-specific properties have to be taken into account. Fourier-based methods such as Fast Fourier Transformation, Periodogram or Welchs method did not provide reliable results for the majority of the cases. Additional methods such as Lomb-Scargle Periodogram or Epoch Folding can be used to refine and confirm the extracted results. The phase reconstruction, which is a manual method, was found to be very helpful for the final confirmation of the extracted frequencies.

We will introduce the AIUB light curve database, which is containing around thousand light curves acquired over more than seven years. Extracted frequencies and reconstructed phases for some interesting targets, e.g. GLONASS satellites, for which also SLR data were available for confirmation, will be presented. Finally we will present the reconstructed phase and its evolution over time of a High Area to Mass Ratio (HAMR) object, which AIUB observed for seven years.