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INTERPRETATION OF LIGHT CURVES BASED ON SIMULATION SOFTWARE

Abstract

The investigation of space debris involves the characterization of orbital objects, which includes the collection of information like orbit, body shape and attitude. Current studies are mainly concerned with methods for precise orbit determination. However, future removal missions will need additional information of the object's state – in particular the rotational state. For this purpose researchers of the Institute of Technical Physics at the German Aerospace Center (DLR) in Stuttgart, Germany started a new research campaign to investigate light curves of space debris.

Light curves are the time-dependent variation of the apparent brightness due to sunlight reflection on the body surface. A light curve is a convolution of various factors like the rotation, phase angle and slant range. In order to determine the body's actual rotational state, it is necessary to understand what the light curve is composed of. Our approach uses forward-modeling of artificial light curves. We simulate a real observation of an orbital object as a virtual scene with a three-dimensional object model, including the reconstruction of the slant range and phase angle by using Two-Line-Element (TLE) sets. This simulation has been realized with our own developed software, allowing us to modify the body shape, reflective properties and rotational dynamics of the model. Applying an existing ray tracing algorithm (POV-Ray) to the described scene finally results in a simulated light curve.

The related light curves of the real object were measured at our research observatory in Stuttgart. Depending on the parameter settings in our simulation, we found a strong correlation between simulated and measured light curves. This allows us to develop basic methods to understand the relationship between rotational state and measured light curve.
In this contribution we will introduce our methods and results, including a new object related symmetry coefficient to calculate the correct angular frequency from the light curve.