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IMPACT OF A ROLLING SHUTTER ON LIGHT CURVES OF RESIDENT SPACE OBJECTS IN HIGH ALTITUDE ORBITS

Abstract

Light curves are time series of the observed brightness of an object, typically by integrating over a broad range of electromagnetic frequencies. From variations in this brightness, properties of such an object, such as rotational periods and reflective or emissive patterns, can be inferred, making them a powerful tool for passive remote observation and information gathering.

We present the first light curves of resident space objects (RSOs) taken with a station of SMARTnet owned and operated by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR). The telescope station used for this purpose, SMART-03, is located in Chile and operated since February 2024. For imaging light curves, a scientific complementary metal-oxide-semiconductor (sCMOS) Kepler4040 camera by Finger Lakes Instrumentation (FLI) has been attached to the 50cm telescope, enabling sub-second observations and readout times. This station is primarily intended to observe objects in the geostationary orbit regime, although targets in other orbital regions can also be observed. The light curves are taken without photometric filters in optical white light.

The sCMOS camera features an electronic rolling shutter, which results in different observation epochs for each pixel row. In this paper, these effects are discussed, a compensation method for time correction is described and the results are presented. For illustration and clarity, different individual light curves of geostationary objects are acquired with different frame rates to show the need for and limitations of the correction method. Finally, the corrected and uncorrected light curves are compared to one another to evaluate the necessity or benefits of the correction effort for different scientific goals and scenarios.