Attitude Determination Techniques on Synthetic Light Curves for Simple Geometry and Attitude Motion Combinations

L. D. J. Blacketer[(1)], H. G. Lewis[(1)], and H. Urrutxua[(2)]

[(1)] University of Southampton, Astronautics Research Group, Highfield Campus, University Road, Hampshire, England SO17 1BJ
[(2)] Universidad Rey Juan Carlos, Calle Tulipan, s/n, 28933 Mostoles, Madrid, Spain

ABSTRACT

It is widely accepted that man-made space debris poses a risk to space-based operations. Further, due to collision activity between 900 - 1000 km, simulations show the number of debris objects may increase even in the absence of future launch traffic. Mitigating debris growth and protecting the existing space infrastructure from the debris environment has therefore become a primary concern of the international space community. These efforts can be broadly distinguished into two categories. The first is to decrease collision activity through increasing the accuracy with which the positions of objects are known. The second is through the removal of objects deemed to be high risk. It is possible that both techniques will be required in order to achieve some target reduction in space debris growth.

In order to improve tracking accuracy across the space object population, new characterizations techniques will need to be developed. Futhermore, these techniques need to be applicable across the entire space object population. Hence there is a move away from large, powerful and expensive systems, towards cheaper and less powerful systems, that can be deployed in large numbers across the globe.

One such example is optical light curves. Optical light curves have heritage in determining properties such as attitude and shape-labeled characteristics of Near-Earth Objects (NEO). However, this typically required some a priori information.

One of the primary questions in light curve analysis for attitude determination is understanding how the relationship between illumination geometry, object shape and attitude motion result in the shape of an observed light curve. Of particular interest is understanding how these parameters interact with respect to the observability of attitude motion, and how distinguishable different rotations are from one another.

This paper examines a number of synthetic light curves, generated with a range of shapes and rotations, and tests the capability of a model to determine the geometry and attitude motion parameters of the synthetic light curve. The results will highlight the conditions of maximum attitude observability for different geometry-attitude combinations.