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LIGHT CURVE ANALYSIS IN SUPPORT OF CLEARSPACE CLEAR ACTIVE DEBRIS REMOVAL MISSION

Abstract

ClearSpace Clear (Clearing the Leo Environment with Active Removal) aims to design a spacecraft that can remove multiple inactive spacecraft from Low Earth Orbit (LEO). It is commissioned by the UK Space Agency as part of a UK initiative to support safe and sustainable space operations. This mission specifically aims to target inactive LEO satellites that were not prepared for capture. Therefore careful consideration must be given to the kinetic state and, in particular, the rotational behaviour of any potential target objects.

We present the results of rotational analysis of seven primary down-selected mission targets and one secondary target for the ClearSpace Clear mission. This analysis was performed on photometry data of both archival data from the Mini-MegaTORTORA (MMT) database and data collected in a follow-up observation campaign by the Deimos Sky Survey (DeSS) sensors in the South of Spain.

Rotational analysis involved using a Lomb Scargle periodogram to identify where repeating structures were evident in the light curve data, and extracting the period associated with those repeating structures. Preliminary study of the archival data revealed that four of these targets were aperiodic, indicating that no repeating structures were seen in the light curves and therefore the satellite was not in stable rotation, nor was there evidence of more complex rotational behaviour such as tumbling. Rotational structure was identified in the remaining light curves and analysis of repeat observations showed that these objects exhibited different time-dependent behaviour ranging from stable but evolving rotation to more complex and unstable behaviour.

Better understanding of the rotational state evolution of these inactive low earth orbit satellites promises to provide insight into the behaviour of inactive spacecraft, to help assess the suitability of these objects as potential targets for future ADR missions and to provide valuable information for future capture mechanism design studies.