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Space Debris Detection, Tracking and Characterization - SST (1)

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LEO UNCATALOGUED SPACE DEBRIS DETECTION AND ORBIT CHARACTERIZATION THROUGH MULTI-SITE OPTICAL OBSERVATIONS

Abstract

In this work we describe a system capable of detecting and tracking uncatalogued objects at LEO, space debris or not publicly available, consisting in a multi-site optical observation infrastructure, which includes both detection and tracking facilities. The detection process consists in an in-house developed technique, that has been successfully used in the past for NEOs discovery, and that we currently have been using to detect LEO uncatalogued objects and build-up a database for almost three years now. This detection process consists in a data-intensive computing stacking method technique, aided with hardware acceleration through GPU-CPU heterogeneous computing, which makes the process enough sensitive to detect uncatalogued objects, and enough fast to create new observation coordinates for the tracking sites based on observations on the detection sites. Our current multi-site infrastructure consists of three sites: 105cm Schmidt Telescope at Kiso Observatory (Japan) for Detection, JAXA Telescope at Siding Spring Observatory (SSO) in New South Wales (Australia) for detection/tracking, and JAXA Telescope at Zadko Observatory in Western Australia for tracking. The steps in the processing pipeline are like this: Kiso and/or SSO sites initiate sky surveys; approximately after each 15 minutes a list of uncatalogued objects currently detected, together with a preliminary set of orbit parameters based on two-coordinates observations, is created and sent to a control center located in JAXA facilities; the tracking site is scheduled with these re-observation coordinates; the object is re-detected in the tracking site and the new re-detected coordinates are sent to the control center; finally the control center gathers all observation coordinates for a particular uncatalogued object, and newer and more accurate orbit parameters are generated, that will be used in consecutive days for further re-detection and improvement of its orbit. The system can detect an object at Kiso (Northern Hemisphere) site and re-detect the same object at SSO or Zadko sites (Southern Hemisphere) in the same or next pass, or detect an object at SSO (Eastern site) and re-detect the same object at Zadko (Western site) in the next pass. Currently we have successfully detected uncatalogued objects at SSO site and re-detected them at Zadko site, and then obtained better orbit parameters, which allowed us to track them during consecutive days. We believe that this system can positively contribute to significantly increase the detection rate of currently uncatalogued space debris and its further orbit characterization.