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RAPID TRACKING, CHARACTERIZATION, AND CATALOGUING OF MULTI-PAYLOAD LAUNCHES TO LOW EARTH ORBIT

Abstract

There are several different data sources used for performing space object cataloging, each with their unique benefits and drawbacks. This paper will focus on describing a method for tracking multi-payload launches in LEO utilizing data derived from electro-optical (EO) systems. EO systems provide a combination of astrometric and photometric insights, both of which can be combined for discriminating between payloads on multi-payload missions. The authors utilize both cued telescope and uncued optical EO systems; the former being important for closely spaced object discrimination, and the latter having the advantage of collecting data on launches without tasking or prior launch nominal information. With these data sources in mind, the desired outcome of this paper is to describe a novel framework which will allow for rapid cataloguing of newly launched payloads. This framework is scalable from single payload to ride-share launches and has been applied successfully to several previous ride-share launches.

At a high level, the framework for rapid cataloguing is comprised of five steps. First, a nominal estimate of the deployment orbit is generated and updated to precisely align with the launch time of the target launch vehicle. Next, data is collected on the target launch vehicle using a network of EO optical fence systems. Using data from the optical fences, an initial orbital determination (IOD) is performed to generate initial candidate states. Finally, the initial candidate states are catalogued, and each candidate is analyzed individually to determine stability, conjunction risk, and object type (i.e. payload versus rocket body).

After describing the framework in-depth, this paper will apply the process to a real-world launch using data collected from a combination of gimbaled and staring array LEO electro-optical systems. With this example, the authors will demonstrate that the framework can discriminate between the upper stage rocket body and over 10 payloads, all of which is accomplished within 72 hours of the launch.