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NORTHSTAR SSA CONSTELLATION PERFORMANCE - A FIRST LOOK

Abstract

On January 31st, 2024, NorthStar, SPIRE and Rocketlab launched the first commercial space-based Space Situational Awareness (SSA) constellation, placing 4 electro-optical satellites into Low Earth Orbit. The infrastructure revolves around a system of systems based on passive data collection from space-based telescopes. NorthStar's patented Concept of Operations (CONOPS) is as key to system performance as the space-based platforms themselves are. Rather than actively pointing at and tracking an object, NorthStar points the satellites in a (nearly) fixed orientation relative to the velocity vector in a pushbroom observation mode, resulting in space objects appearing as streaks due to the relative motion of target and sensor. Streak processing produces a vast amount of temporal information not available to ground-based systems, such as relative velocity measurements and accurate astrometric calibration. Continuously framed at a nominal 1 Hz rate, each camera captures the star field and any Resident Space Objects (RSO's) based on streak length and orientation, regardless of the orbital regime. Every satellite downlinks its data once per orbit, roughly 15 times per day. The data is processed at the Data Center in Montreal, QC, Canada. RSO detections are derived using a combination of image processing, astrodynamics, and machine learning algorithms. Each individual satellite generates over 5,000 images per orbit, so by the time of the 2024 IAC conference, close to 60 million total images will have been generated, assuming nominal operations. The data will provide ample opportunity to evaluate the initial performance of the space infrastructure and ground processing capabilities of the NorthStar system. While obviously not being indicative of the performance numbers of the eventual full constellation of 24 satellites in eight different orbital planes, they do permit an evaluation of the first generation optical sensors, and of the system capabilities of object detection and classification in all orbit regimes for those RSO's visible to this initial set. This paper will present performance results of the first few months of operations, in the form of general statistics, with a closer look at a limited number of use cases. The operational data has been collected, catalogued and analyzed to assess the actual results. The general space system operations and infrastructure will be briefly reviewed for the sake of context, but primarily the focus will be on the output data itself, specifically the percentage of RSO's detected and tracked by orbit regime, revisit rates, covariance data statistics, and other factors.