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The NEOCam Science Data System

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ABSTRACT

The Near-Earth Object Camera (NEOCam) is a space mission designed to discover, track, and characterize the majority of NEOs large enough to cause severe regional damage, and large numbers of smaller objects. NEOCam repeatedly images over 1300 deg² of sky in two mid-infrared wavelength bands each day, and will detect approximately 100,000 or more NEOs and millions of more distant small bodies over the life of the mission. In addition to solar system object detections, NEOCam will produce a massive archive of calibrated infrared images and extracted source information that will be provided to the community via NASA archives to enable a broad range of asteroid and comet precovery and other follow-up studies.

Because of its high data rate, the complexity of detecting solar system objects against the dense background of astrophysical sources, and the need to report moving object candidates to the IAU Minor Planet Center within 72 hours of detection, NEOCam is as much a challenging software project as it is a hardware project. Here we describe the design and development of the NEOCam Science Data System (NSDS). The NSDS ingests raw science data and flight system telemetry, converts the raw data to fully calibrated image and extracted source data products, detects moving solar system object candidates from the data stream, performs automated quality assessment on the data products, and delivers those

data products to NASA archives. The NSDS is being developed by IPAC at Caltech, and is modeled closely on the successful science systems implemented and operated by IPAC for the Two Micron All-Sky Survey, WISE/NEOWISE and the Zwicky Transient Facility. The NSDS is a highly automated, high throughput software and operations system that uses robust calibration and processing pipelines, and innovative image differencing techniques to detect and vet candidate moving objects, and to link these into moving object tracklet candidates. Like the predecessor missions, the NSDS will make use of highly automated science data quality assurance to vet data products and monitor system performance continuously during the NEOCam survey.

The core processing functionality of the NSDS is developed early during NEOCam mission implementation for two reasons. First, the NSDS plays a key role as a systems engineering tool. The NSDS is used in concert with the NEOCam Survey Simulator and Instrument ground test results to verify overall system performance with respect to the missions Level 1 Requirements, and to support design trade studies. Second, the NSDS must operate with high efficiency and accuracy very shortly after NEOCam launch. Therefore, the system must be mature and well-tested prior to launch and checkout unlike the science systems for other Planetary missions that have either much less complex data products or have long cruise phases during which the science systems can be developed.
