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NEOCam Survey Cadence: Discovery, Self Followup and Orbital Quality

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Abstract

The Near-Earth Object Camera (NEOCam) is a proposed space telescope with the capability to discover, track and characterize at least two-thirds of potentially hazardous asteroids (PHAs) with diameters larger than 140m. These PHAs are large enough to cause significant regional damage, and the U.S. Congress has tasked NASA with finding at least 90% of them by 2020 [1]. NEOCam is expected to detect thousands of comets, hundreds of thousands of Near-Earth Objects (NEOs) and millions of main belt asteroids. Since moving objects, in particular NEOs, are the main focus of the NEOCam mission, the survey can be optimized for maximum discovery rate by adjusting the survey cadence to ensure efficient and reliable linking observations into tracklets, which are position-time sets of a minor planet. It is also important for the survey cadence to provide self-followup that yields orbits with quality similar to that of the known NEOs today.

The NEOCam Survey Simulator (NSS) is a set of tools being developed to support the efforts to optimize the survey and verify the ability of the designed mission to meet its scientific objectives. The NSS consists of a comprehensive representation of the mission performance, including the flight system hardware, mission operations, and ground data system processing. The NSS takes as its input a reference population of solar system bodies, the NEOCam Reference Small Body Population Model (RSBPM; see abstract by T. Spahr), and performs a frame-by-frame simulation of the survey over the course of its entire operational lifetime. Note that the RSBPM allows for performance to be evaluated as a function of diameter, rather than the traditional method of equating absolute magnitude H = 22 mag as a proxy for 140m. It has been shown that a completeness of 90% of objects with $H < 23$ mag is needed in order to ensure that 90% of objects larger than 140 m are found [2].

We present here our ongoing work on mission architecture trades and the optimization of the survey cadence for NEO discovery and tracking [3, 4]. We will present the latest NEOCam survey cadence and its expected performance. Current best estimates yield a completeness rate of the NEOs larger than 140 m of $\sim 76\%$ after the five year nominal survey. This can improved to $\sim 82\%$ after an additional 5 year extended survey. Studies have shown that the 90% goal can be achieved by a combination of a space mission like NEOCam and a ground based survey like LSST [5]. We will also present how the survey cadence provides self-followup of the NEOs population and ensures orbital quality on par with the current NEO population (see Figures 1 and 2).

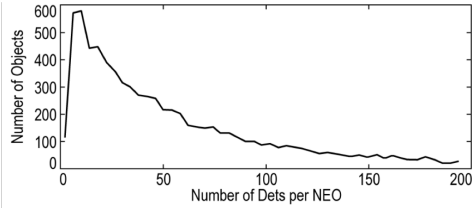

Figure 1: Histogram showing the number of detections expected for a set of NEOs during the five year nominal mission lifetime. While most NEOs will get 12-16 observations, a significant fraction of NEOs will get 50+ observations over the prime mission lifetime.

Acknowledgements

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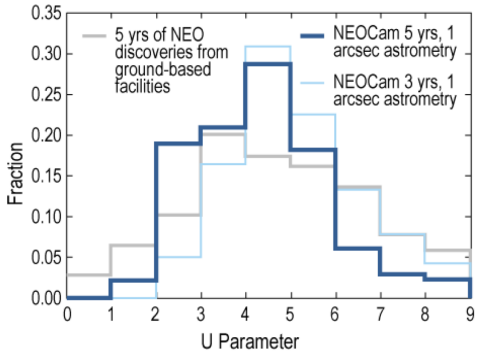

Figure 2: The NEO orbital quality from the NEOCam baseline survey cadence is superior to the quality provided by the current surveys and reported to the Minor Planet Center over a similar 5 year time frame.

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