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ANT-2: A ROBUST 1.5U CUBESAT TELESCOPE FOR EARTH OBSERVATION

Abstract

The Advanced Nanosat Telescope 2 (ANT-2) instrument is a refined mature follow-up design of the earlier ANT. The ANT-2 instrument is a robust compact 1.5U Nanosat camera meant to serve niche Earth observation markets with a rapid and cheap solution. The current design covers a low to medium spatial resolution (5 to 10 m) within a wavelength band from Blue (4000 nm) to Near Infra-Red (1000 nm). It has the potential to be the cornerstone solution of a constellation of ANT-2's to support a future synthetic aperture Earth observation network. The 1.5U plug-and-play design contains a folded light-path instead of a deployable optical system. The result is an ultra-stable opto-mechanical design in terms of thermo-mechanical stability. The light weighted, small of volume 1.5U structure complies with an integration of a standard triple unit (3U) Cubesat.

The current improved design is based on a Ritchy-Chretien system with a larger aperture and a better Signal-to-Noise Ratio (SNR). The increase in wavelength bandwidth has been achieved using more mirrors. The detailed tolerance analysis based on the incorporation of a MEMS calibration subsystem shows promising potentials. One of them is the ability of the system to reduce the sensitivity of the optical performance due to misalignment, manufacturing errors and at the same time thermal excursions. At achievable manufacturing tolerances it can guarantee a certain precision and adjustment of elements using MEMS to re-focus and calibrate the system. The thermo-dynamical stability range within (100-200 μm) is further improved by actively moving the sensor or lens elements. This ensures that the system remains in focus regardless of the temperature. The latter adds complexity to the design asking for a two-step (coarse, fine) control strategy with multiple MEMS.

The article focuses on the bottom-up system engineering analysis results of the instrument, i.e., MEMS performance, opto-mechanical stability, SNR and the (constellation) Modulation Transfer Function (MTF). The MTF system analysis is related to the derived spacecraft platform stability and Attitude Determination and Control System requirements. The first assessments of the design compliance with the Cubsat bus architecture will be given. The instrument development is explored in narrow corporation with our high-tech partners related to the chair Space Systems Engineering.

Keywords: Earth Observation, cubesat, synthetic aperture, miniaturization, optical instrument, cornerstone solution, thermal-stability, nanosat, MEMS, calibration.