Paper ID: 68547
oral

29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Dr. Boris Segret
Observatoire de Paris, France

IMAGE-BASED CHARACTERIZATION OF A CUBESAT'S ADCS

Abstract

Attitude Determination and Control Systems (ADCS) for nanosatellites in the NewSpace sector are frequently offered as Commercial-Off-The-Shelves (COTS). However, while the systems are expensive and critical for the missions, their behavior after integration in the platform is difficult to test on ground, and even more to prove in flight. Although the sensitivity of nanosatellite sensors is limited, image-based techniques are efficient to characterize the accuracy and the stability of the platform in detail. This talk will present our progress at assessing the inertial pointing accuracy and stability of OPS-SAT, a CubeSat currently in orbit and operated by the European Space Agency (ESA), making use of on-board images of stars. The imager and the ADCS are both typical CubeSat hardware provided and integrated as COTS. The ADCS sensors are a Star Tracker (ST), gyrometers and magnetometers, a sun sensor and photodiodes. The actuators are reaction wheels and magnettorquers. The imager is directed to the $-Z$ longitudinal axis, while the ST points in the (X, Y) plane. Nadir pointing has proved satisfactory for Earth imaging. However, the inertial pointing (i.e. to the dark sky) appeared unaccurate and unstable and multiple sequences have been tested to improve the operations. In parallel, images are taken and a complex post-processing has been developed to extract useful information from the faint stars seen in the images. It allows the quantification of APE (Absolute Pointing Error) and AKE (Attitude Knowledge Error). Then, we will also show how the imaging made us improve the pointing sequence. Although the stars produce very faint signal due to the spreading of their light over tens of pixels, we could eventually detect and use them for the analysis. Moreover, the processing has been complex and partially manual, but its automatization is considered for upload as an on-board "rescue" star tracker to feed the ADCS with a new source of attitude measurements. The OPS-SAT experience gained by CENSUS at Paris Observatory - PSL is being re-used as a generic approach for new nanosatellites, to specify damping and jitter requirements, to request qualification tests at the procurement stage and to anticipate commissioning operations.