Paper ID: 68394
interactive

IAF EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM (IP)

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BRIDGING THE GAP: RECENT ADVANCES IN SMALLSAT CAL/VAL TECHNOLOGY (THROUGHOUT THE MISSION LIFE CYCLE)

Abstract

Optical Earth Observation payloads for CubeSats have dramatically improved in performance, now rivalling those intended for larger satellites. In order to produce data that can be complementary and comparable to traditional earth observation missions such as Landsat and Sentinel 2, use of these systems poses unique challenges. Such challenges result from the compact optical assembly with COTS matrix detectors developed for machine vision. Good sensor characterisation that remains stable is dependent on a solid sensor design, a robust prelaunch characterisation and calibration (CalVal), extensive CalVal during a shortened commissioning phase after launch, and continuous CalVal during the operational phase of the mission. All of this must be done with a fraction of the budget that would normally be available for traditional larger Earth Observation Payloads. In order to achieve this, pre-launch, commissioning, and operational phase CalVal, need to be highly automated and offered as a service to satellite operators. This paper presents such CalVal routines, starting with a description of optical payload designs for CubeSats, and the constraints and limitations they pose. This is followed by a description of prelaunch CalVal routines and the resulting characterisation. As sensors are subjected to considerable environmental stresses during launch and in space, the CalVal processes during the commissioning phase are of great importance. To maintain image quality over the mission duration, CalVal operations need to be conducted periodically during the operational phase of a mission, thereby compensating for sensor degradation. All of these CalVal processes are automated to meet budget and time constraints unique to CubeSats. The unique sensor designs and CalVal processes enable the generation of image products and processing levels conformant to Committee on Earth Observation Satellites (CEOS) standards, culminating with the generation of Level-2 products adhering to the threshold requirements of the CEOS Analysis Ready Data for Land – Surface Reflectance (CARD4L-SR) standard. This allows CubeSats to pave the way as a valuable contributor into the Earth Observation application market. Furthermore, through effective tipping and cueing methods, it is possible to acquire actionable data that can be consumed for quantitative analysis and geo-intelligence solutions, complementing datasets generated by traditional larger systems.