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COMMISSIONING PHASE CALIBRATION OF A HYPERSPECTRAL CAMERA WITH SCALABLE FILTERS

Abstract

Commissioning phase calibration of hyperspectral cameras with scalable filters presents unique challenges, as demonstrated by the HyperScape 100 CubeSat earth observation payload. With 442 selectable bands at 1nm increments, only 32 bands can be read out at any given time, complicating radiometric and geometric characterization using conventional calibration techniques. In this study, we employ a multi-faceted approach to address these challenges and achieve comprehensive sensor calibration.

Pre-launch sensor characterization serves as a critical foundation for post-launch calibration efforts. Guided by pre-launch measurements, the commissioning phase calibration leverages a unique snapshot imaging mode to radiometrically characterize all detectors within the matrix sensor. This approach enables accurate measurements of the radiometric response, spectral response and internal geometric orientation of the sensor and spatial response characterization in terms of modulation transfer function (MTF).

To enhance calibration accuracy, further snapshot images are acquired over CEOS Cal/Val sites during the commissioning phase. Additionally, third-party hyperspectral imagery from well-calibrated sources such as DESIS, PRISMA, and EnMAP is integrated into the calibration process. These snapshot images, acquired and calibrated during commissioning, facilitate normal image acquisition in push broom mode. Utilizing digital Time Delay Integration (TDI) in push broom acquisition improves signal-to-noise ratio and allows for variable spectral band width.

The calibration technique based on snapshot imagery ensures comprehensive characterization of the sensor for all push broom imaging configurations. Moreover, this approach fully characterizes the effect of temperature on radiometric, spatial, and geometric properties, enhancing the instrument's reliability and performance in earth observation missions.

In summary, the integration of pre-launch measurements, snapshot imaging, and third-party hyperspectral data enables thorough commissioning phase calibration of the HyperScape 100. This holistic approach addresses the challenges associated with hyperspectral camera calibration in CubeSat payloads, paving the way for improved earth observation capabilities.