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FLUORESCENCE IMAGING SPECTROMETER (FLORIS): A HIGH ACCURACY INSTRUMENT WITH PROVEN TECHNOLOGIES AND ROBUST DESIGN

Abstract

The Fluorescence Explorer (FLEX) mission is a candidate of the ESA's 8th Earth Explorer opportunity mission. FLORIS is a pushbroom hyperspectral imager, foreseen to be embarked on board of a medium size satellite, flying in tandem with Sentinel-3 in a Sun synchronous orbit at a height of about 815 km. FLORIS will observe the vegetation fluorescence in the visible spectral range (500-780 nm) at medium spatial resolution (300 m) for vegetation health evaluation by means also of the data of Sentinel 3 mission (vegetation colour and land temperature). Earth scenes are acquired in two spectral channels, High Resolution (HR) and Low Resolution (LR), with spectral resolution of 0.3 and 2 nm respectively and spectral oversampling of a factor 3. The ESA-funded phase A-B1 study has been devoted to demonstrating the system feasibility and a breadboard activity is on-going. A common fore optic enhances by design the spatial co-registration between the two spectral channels, with 300 m of spatial sampling and 147 km of swath, while an overlapped spectral range simplifies the spectral co-registration. A thermally stabilized aluminum optical bench and three cooled back-sided illuminated and fast CCDs are used to guarantee the required SNR and the stability accuracy (spectral and radiometric) between two successive on board calibrations. The absolute radiometric calibration is achieved by observing a dedicated sun illuminated Lambertian diffuser, with a solar port, while the spectral calibration is done by using the atmospheric absorption lines. The thermal stabilization is achieved by using two passive radiators looking directly to the cold space and heaters in a closed loop system. The CCD design is improved for high clouds signal measurements, mitigating smearing effects during reading. A compact opto-mechanical solution with all spherical and plane optical elements is proposed. A dual Babinet scrambler is placed in front of the telescope in order to reduce the polarization degree of the incoming light. A camera lens is used to image the ground scene onto a double slit. Then the radiation is dispersed onto two detectors by means of the HR and LR grating spectrometers in a modified Offnr configuration (VIRTIS, VIMS heritage). Special attention has been given to the mitigation of spatial and spectral stray-light which could impact on the fluorescence measurement accuracy. The opto-mechanical design is robust, stable vs temperature, easy to align, showing high optical quality with excellent corrections (by design) of transverse aberration and distortions (keystone and smile).