

Radiometric and Spectral Onboard Calibration Concepts of Hyperspectral Sensors - Specifics of EnMAP and DESIS

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Abstract:

Currently ecological and climatological scientific tasks in land and water applications demand a new quality in remote sensing data information. There is a need for combined high spatial and spectral resolution, with a number of about 100 channels and a pixel ground resolution down to 30 m. Both optical instruments HSI (Hyperspectral Imager in the EnMAP mission) and DESIS (developed by DLR for the MUSES platform of the ISS), will provide these demands. Within the EnMAP and DESIS missions, we have two hyperspectral instruments with very similar design concepts, but different on-board capabilities to track the instrument behavior in orbit. Amongst others, it is very important to monitor the development of instrument quality and especially the radiometric and spectral properties over the entire mission time to ensure a high data quality for the scientific interpretation methodology. The presentation will focus onto the similarities and differences between both instruments regarding the on-board calibration tasks, due to the different equipment available in both instruments. As introduction the most important instrument and mission characteristics such as detectors used, orbit parameters, wavelength range, spectral and ground resolution are compared. The main focus will then be on the practical realization of the concrete task of absolute radiometric and spectral characterization during the flight. There will be explained the very different equipment which is available for the instruments. The calibration consists of three main parts: the dark signal measurements, the absolute radiometric control and alignment, and the spectral assignment and correction of the detector elements. The basic prerequisite is, of course, absolute and precise laboratory calibration on-ground, so that the adjustments and corrections to be expected and carried out in-flight are of small order of magnitude. The on-board calibration methodology therefore is a combination of monitoring and correction activities.

In the HSI (EnMAP), there are two separate main assemblies for monitoring absolute radiometric and spectral properties, a white Spectralon[®] plate used in sun calibration measurements, and an internal, artificially illuminated white sphere doped with the oxides of rare earth elements to obtain defined spectral features (see figure 1). In contrast to this, the DESIS instrument uses a calibration unit consisting of two array banks of white and monochromatic LEDs that can be combined spectrally at different illumination levels (see figure 2).

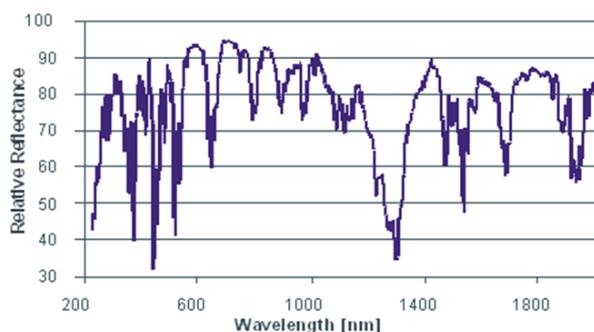


Figure 1: Spectrum of doped Spectralon[®] used for the assessment of the spectral calibration of EnMAP (© OHB)

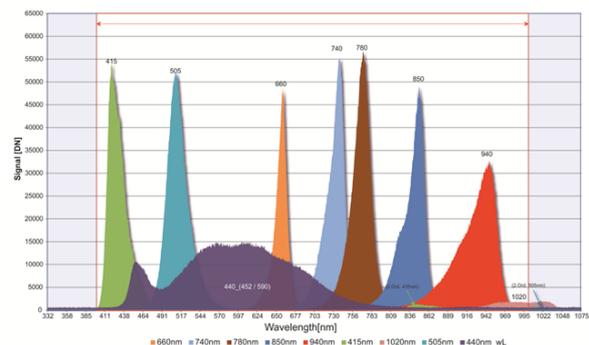


Figure 2: LED spectra of the DESIS calibration unit (DLR OS)

This allows the estimation of the radiometric and spectral behavior of the instrument, but with different analysis methodology compared to EnMAP. The details of the calibration concepts are shown and explained in the presentation.