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Hyper-Spectral Imaging for Earth Observation Applications

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In this study, we present a hyper-spectral imaging (HSI) system that focuses on the spectral window 470-970 nm and meets the demands of static sampling and remote sensing when mounted on an Unmanned Aerial System (UAS).

The system comprises two HS cameras, a compact industrial PC and a battery pack. It has a total weight of <1.8kg, including the bracket for mounting to an active DJI Ronin gimbal. A labview interface was also developed to collect, process and analyse the images from the two HS cameras. The software has the ability to set the parameters for the cameras' exposure times and capture frequency, while it can provide the digital counts at a single point of the image or the averaged counts over a rectangular area of the image. For the purposes of aerial applications, the program provides the ability of delayed start and sequentially image capture.

For the calibration of the raw HS images, an offline workflow is developed to derive absolute reflectance values. The processing chain includes dark and vignetting correction, spectral response characterization, digital number to reflectance conversion and hyperspectral data cube reconstruction.

The system has been already deployed in several in house studies: detection of dothistroma in Scots pine needles, starch detection in apples and bananas, and avocados maturity indication, while aerial imagery was also acquired during field campaigns in the UK and China aiming to create a tree species distribution map and to early identify tree health issues.

The development of the system is dynamic as technology is moving forward and the demand for light-weighted multi-sensor UAS surveys is increased during the last decade. Furthermore, the calibration processes and data analysis techniques are constantly updated to meet international requirements and push the accuracy of the products to the highest standards.