DESIGN OF A NIR-SWIR IMAGING SYSTEM FOR SMALL SATELLITES – IAA-LA-17-P18

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This paper presents a small, low power consumption, and selectable between broadband and band-tunable NIR-SWIR imaging system for CubeSat satellites. The camera consists of a flexible and customized lens design that allows modifications to fit customers specifications and an off-the-shelf NIR-SWIR high resolution sensor with its electronics integrated for cost-effective, easy production and testing. The resulting instrument fits in 1U, wights less than 500g, consumes between 4W and 8.5W during nominal operation depending on base-plate or ambient conditions, and produces 12bits images at a maximum data rate of 504Mb/s. The detector is a high resolution InGaAs featuring 1280x1024 pixels with 12.5um pixel pitch. The built in electronics interface is a Camera Link interface for data transfer and operation. The power requirements for the instrument are DC +8V - +16V.

The OEM module that includes the focal plane array (FPA) and the electronics for control and interface with the satellite has been tested to MIL-STD-810G for functional shock, vibration, thermal shock, storage temperature, altitude, humidity and acceleration. The Operating temperature is -40ºC to 70ºC

The InGaAs sensor is an extended range that is sensitive from 700nm to 1700nm. It is a high sensitivity sensor suitable to provide real-time daylight to low-light imaging in the Near Infrared (NIR) and Short Wave Infrared (SWIR) wavelength spectrum for persistent surveillance, laser detection, penetration through fog, dust, and smoke. In addition, the instrument employs on-board Automatic Gain Control (AGC) and built-in non-uniformity corrections (NUCs), allowing it to address the challenges of high-dynamic-range urban nightimaging without blooming. The Instrument has also the capability to receive and execute commands for gain and integration time adjustment.

The lens design presented in this paper is the result of the Optics Courses taught at the Maestría en Instrumentos Satelitales (MIS) that belongs to the Facultad Regional Mendoza from Universidad Tecnológica Nacional (UTN-FRM) and the Unidad de Formación Superior from Comisión Nacional de Actividades Espaciales (UFS-CONAE). The design is a broadband lens design that has an overall transmission higher than 90% in between 750nm and 1640nm. The design is also telecentric to allow coating deposition for customized filter deposition if needed by the customer on a sapphire window included in the OEM and the lens design. In this paper transmission and tolerance analysis are shown and geometric and radiometric calculation examples are presented for selected bands.