OIP Sensor Systems

SATIRIM 2

EXECUTIVE SUMMARY REPORT

REPORT [OIP-ESR]

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1 EXECUTIVE SUMMARY

In this contract OIP and its subcontractor VITO, have investigated the application of uncooled microbolometer detectors in thermal imagers for space missions. In particular, it was investigated if this technology is suitable for earth observation, with special attention to the measurement of evapotranspiration of the earth's vegetation. Evapotranspiration is the loss of water by plants, by both evaporation and transpiration.

New emerging markets are targeted that can benefit from the usage of thermal bands. Measurements in the thermal infrared (8-12.5 μm) offer the possibility to determine surface temperature, allowing several applications like for geology, forestry, agriculture, water applications etc. Focusing on agriculture there is a potential for predicting water stress in crops, planning irrigation scheduling, disease and pathogen detection in plants, evaluating the maturing of fruits etc. Two or three spectral bands in the 8-12.5 μm range will be used to establish the temperature. However, there is also a need for combination of VNIR/SWIR data for atmospheric correction, cloud detection and estimation of the emissivity of the observed surface. The main end-user product is the evapotranspiration map.

The final goal would be to deploy a cubesat constellation, each cubesat using an uncooled microbolometer as thermal imager to provide (near-) daily coverage.

During the preceding project Satirim 1, VITO established the scientific requirements of such a mission. OIP investigated if and how these scientific requirements could be achieved. It was evident quite early that a relatively large optical system would be needed. A major conclusion of this study was that microbolometer detectors that are suitable for use in space missions are commercially available. They can withstand the space environment and maintain their performance.

This project Satirim 2 further elaborated to these findings. To investigate this in further detail, a commercially available microbolometer detector was integrated in a breadboard of a thermal imager.

The complete breadboard setup consisted of an objective lens, microbolometer sensor, readout electronics, framegrabber and computer. The microbolometer with it's electronics and objective were placed into a climate chamber together with a blackbody. By this way, a thermal image of a certain scene can be easily captured and stored on the computer.
Satirim 2 consisted out of two phases.

During phase 1 testing, a large number of images of a uniform scene were made. This was done for a range of temperatures of the scene and camera environment (i.e. climate chamber temperature). Scene temperatures have been implemented by placing a blackbody over the entire FOV of the camera. The radiation reaching the sensor was artificially adapted using apertures to the levels which would be seen in a typical space flight.

During phase 2, the same measurements were conducted with the camera and a blackbody inside a climate chamber. However, a dedicated (proximity) ROE was developed during this phase. Phase 1 used an COTS ROE. The purpose is to demonstrate an improved performance, which has been proven to be successful.