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ABSTRACT:

MULTI-SPECTRAL OPTICAL SCANNERS FOR COMMERCIAL EARTH OBSERVATION MISSIONS

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Topic 5: Generic Technologies and Simulations for Space Optical Instruments

In recent years, a number of commercial Earth observation missions have been initiated with the aim to gather data in the visible and near-infrared wavelength range. Some of these missions aim at medium resolution (5 to 10 m) multi-spectral imaging with the special background of daily revisiting. Typical applications aim at monitoring of farming area for growth control and harvest prediction, irrigation control, or disaster monitoring such as hail damage in farming, or flood survey.

In order to arrive at profitable business plans for such missions, it is mandatory to establish the space segment, i.e. the spacecraft with their opto-electronic payloads, at minimum cost while guaranteeing maximum reliability for mission success. As multiple spacecraft are required for daily revisiting, the solutions are typically based on micro-satellites.

This paper presents designs for multi-spectral opto-electric scanners for this type of missions. These designs are driven by minimum mass and power budgets of micro-satellites, and the need for minimum cost.

As a consequence, it is mandatory to arrive at thermally robust, compact telescope designs. The paper gives a comparison between refractive, catadioptric, and TMA optics. For mirror designs, aluminium and Zerodur mirror technologies are briefly discussed.

State-of-the art focal plane designs are presented. The paper also addresses the choice of detector technologies such as CCDs and CMOS Active Pixel Sensors.

The electronics of the multi-spectral scanners represent the main design driver regarding power consumption, reliability, and (most often) cost. It can be subdivided into the detector drive electronics, analog and digital data processing chains, the data mass memory unit, formatting and down - linking units, payload control electronics, and local power supply. The paper gives overviews and trade-offs between data compression strategies and electronics solutions, mass memory unit designs, and data formatting approaches. Special emphasis will be put on space application aspects of these electronics solutions such as radiation total dose tolerance and single events robustness.

Finally, software architecture and operational modes of commercial multi-spectral scanners are discussed. They are driven by operational requirements and mission constraints such as data takes per orbit, number of downlink ground stations, calibration needs, and mission schedule planning.