IAF EARTH OBSERVATION SYMPOSIUM (B1)
Future Earth Observation Systems (2)

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HIVE, AN AGILE MICROSATELLITE CONSTELLATION FOR THERMAL INFRARED EARTH OBSERVATION ENABLING "MORE CROP PER DROP".

Abstract

HiVE (High-resolution VEgetation monitoring mission) is going to be the world's first microsatellite constellation for thermal infrared (TIR) land surface temperature monitoring. In development by a consortium led by ConstellR GmbH, a German newspace start-up, together with OHB System, NanoAvionics and Fraunhofer EMI, its goal is to provide global land surface temperature imagery optimised for high-precision agriculture, water management, temperature-derived crop health management, yield forecasting and sustainable resource management. Sub-field crop monitoring calls for high resolution imagery, day-to-day planning requires high revisit frequencies and operational use demand low latencies for data and analytics delivery. Due to its commercial nature, the constellation aims to be cost-efficient via the use of commercial-off-the-shelves components, while providing all key capabilities.

The HiVE constellation mission architecture comprises multiple operational concepts including virtual

calibration for payload miniaturization and dynamic tasking/targeting, serving more users/payload. By introducing novel operational concepts, the required payload mass and volume can be minimised, thereby reducing space segment costs to a fraction of current systems whilst ensuring high radiometric precision.

Each satellite is equipped with a multispectral TIR cryocooled sensor, delivering the main mission data, and a multispectral VNIR to enable precise geolocation, atmospheric correction and cloud detection. The TIR payload is developed by OHB and is able to record, with high radiometric accuracy, three spectral bands using a push-frame scanning scheme. The payload brain is an instrument control and data processing unit, developed at Fraunhofer EMI, based on a single COTS heterogenous multiprocessor system-on-a-chip and is capable of onboard data processing such as image correction and data compression. The satellite platform is based on the NanoAvionics versatile MP42 microsatellite bus, whose performance is optimized for remote sensing, high data throughput, high agility and high attitude stability.

The first generation of the satellites will target the delivery of 1-day global revisit, 50m ground resolution in TIR and 15m in VNIR. To achieve the targeted revisit time as well as being flexible and highly responsive to customers' requests, each satellite will be able to target preselected areas of interest. The satellites are designed such that it can operate either in mapping mode, where continuous stripes are recorded, or in targeting mode, where specific targets are pre-selected by the mission planning within the field-of-regard of the satellite. For this, the microsatellite needs to be agile and highly stable during imaging: particular attention is being put on the mechanical and AOCS design, the micro-vibration environment, and the concept of operations.