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SOFTWARE DESIGN AND IMPLEMENTATION OF A MULTI-CAMERA EARTH OBSERVATION PAYLOAD

Abstract

TUBIN is a microsatellite of roughly 20 kg designed for Earth observation aiming at the detection of high-temperature events using microbolometer technology sensitive in the thermal infrared light spectrum. In order to achieve its mission objectives, the satellite carries two microbolometers in combination with a visible spectrum CMOS camera as main payloads. The TUBIN satellite mission is based on the modular microsatellite platform TUBiX20 of Technische Universität Berlin that was first demonstrated on orbit in 2017 with the technology demonstration mission TechnoSat.

To reduce the complexity in hard- and software and to maximize the reusability of its components, all three payload cameras are based on an in-house developed modular camera electronics stack. The stack is comprised of four printed circuit boards that realize the interface to the spacecraft, the sensor readout and processing electronics as well as the camera's power conditioning and the imaging sensor, respectively. In this manner, the implementation of different camera types, as visible and infrared within the TUBIN mission, is solely achieved by exchanging the imaging sensor board.

The camera software is comprised of different loosely coupled applications running on a custom-built Linux operating system. Its design is focused on supporting the modularity of the camera hardware and on maximizing the usage of flight-proven code, design rules and toolsets of the TUBiX20 platform. Examples of platform software reuse are the TUBiX20 FDIR architecture with periodic alive and anomaly messages as well as telecommand and telemetry message formats.

One of TUBIN's secondary mission objectives is the demonstration of in-orbit payload data processing. To this end, the camera hardware offers enhanced processing power that will for example allow for the pre-selection of imagery prior to payload data downlink. Exploiting the Ethernet network shared among the cameras and the PDH, data exchange between the imagers with the aim of enabling multispectral data processing is enabled.

This paper gives a software centered overview of the concept, design and implementation of TUBIN's multi-camera payload. In addition, it will be shown how the integration of flight proven platform software components and existing development infrastructure benefitted the design and implementation of the cameras' software.