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# REAL-TIME PAYLOAD DATA PROCESSING ON THE FPGA-BASED ON-BOARD COMPUTER OF THE MICRO-SATELLITE "FLYING LAPTOP"

**Abstract**

On-board computers (OBCs) based on microprocessors are typically not designed to perform substantial computational tasks due to their demanding power consumption and their relatively low computational performance. The use of ancillary ASICs can correct this short-coming, but impairs the operational flexibility of the system. Field Programmable Gate Array (FPGA) technology plays the key role to overcome this issue in combining full flexibility during operation with medium power consumption and high computational throughput.

The micro-satellite "Flying Laptop" is a 3-axis stabilized micro-satellite with a mass of about 100 kg and currently under development at the Institute of Space Systems of the Universitaet Stuttgart. Its mission comprises scientific Earth observation and technology demonstration. The satellite carries a FPGA-based OBC, which constitutes a central element for both objectives. This configurable, redundant and self-controlling device consists of four Central Processing Nodes and one Command Decoder / Voter. By its parallel processing capabilities it enables the satellite to perform extensive data processing. Starting with the raw sensor data, the OBC performs radiometric sensor corrections, as well as, geometric corrections accounting for sensor non-idealities, the Earth's curvature and the nadir offset angle of the sensor platform. Further processing such as image co-registration, mosaicking and classification can be used for various applications. Moreover, the data volume has to be reduced by image screening, analysis and compression as the generated amount of payload data is not manageable in the classic "store and forward" manner.

This paper describes the payload data processing chain on-board the micro-satellite "Flying Laptop" comprising the mentioned processing steps. It demonstrates the benefits of the FPGA-based OBC in terms of computational performance and flexibility.