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THE ERNST MISSION: MWIR IMAGING AND ADVANCED TECHNOLOGY DEMONSTRATION IN A 12 U NANOSATELLITE

Abstract

The ERNST (Experimental Spacecraft based on Nanosatellite Technology) mission is both an advanced MWIR imaging satellite as well as a technology demonstrator. The 12 U nanosatellite is based on off-the-shelf CubeSat components where appropriate parts are available. All other subsystems and especially the main payloads are designed and built by Fraunhofer. The overall mission goal is to evaluate the utility of a large nanosatellite mission for scientific and military purposes.

ERNST's primary payload is a high-resolution mid-wavelength-infrared camera that is actively cooled by a Stirling cryo-cooler. This payload generates very demanding requirements for the satellite bus and exceeds the capabilities that are normally associated with CubeSats. This payload also demonstrates on-board data-processing using state-of-the-art FPGA technology and comprises a filter pendulum mechanism for switching between several spectral bands. The payload data is transmitted to the ground segment in X-Band. All components of this payload are mounted on an optical bench which has been designed using numerical topology optimization methods and is 3D-printed from an aluminum alloy. Integrated into this optical bench is a 3D-structured radiator that dissipates the heat generated by the cryo-cooler.

The second payload is a radiation sensor by Fraunhofer INT that characterizes the radiation environment in ERNST's orbit by measuring electrons and protons from the radiation belts and from solar storms. The radiation sensing is based solely on counting the number of changed bits in memory devices behind different shielding thicknesses to distinguish between different types of particles and energies. Furthermore, ERNST hosts an optical camera payload in the visual spectrum.

The ERNST 12U platform provides flexible payload capabilities with high-data rate processing and download, as well as 60 W beginning-of-life power provided by two deployable solar arrays. The most complex mechanism on board is a drag-sail subsystem to de-orbit the ERNST nanosatellite after its mission end for ensuring the sustainability of space applications.

This paper gives an overview on the mission status and spacecraft design. It describes the main payloads as well as the technology demonstrated. In addition, first results from the qualification campaign which takes place during 2019 will be presented. This includes data from thermal-vacuum, vibration and radiation tests with the engineering qualification model. The launch of the ERNST Flight Model is planned for beginning of 2021.