IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

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PRELIMINARY DESIGN OF A MULTISPECTRAL IMAGING SYSTEM FOR THE CHEMICAL CHARACTERIZATION OF ENCELADUS LANDING SITE (MIMESIS)

Abstract

Saturn's moon Enceladus is famous for its peculiar state, being one of the brightest and youngest bodies in our Solar System. Cassini mission performed a series of Enceladus flybys that led to the discovery of geysers and plumes erupting from the moon's South Pole, the global sub-glacial ocean and how it's interacting with the extreme Saturnian environment. Yet with all, the collected scientific measurements are characterized by a limited resolution mainly due to the constraints introduced by such flybys. For this reason, in future lander missions, it will be required to improve the knowledge of such an intriguing body before any ground activity can take place. To achieve the success of such missions, detailed knowledge of Enceladus' surface features and properties is required.

MIMESiS project wants to suggest a possible scientific mission exploiting several Disposable Units (DUs), each of them has a size comparable to a 3U CubeSat. The aim is to acquire multispectral images of possible landing sites in the Visible-Near Infrared (VNIR) and Mid Infrared (MIR) spectral bands. Such operation occurs during the DUs re-entry phase, after their detachment from the main orbiter, allowing the reconstruction of the surface composition and its morphology to later choose the most appropriate location for on-ground operations (e.g. rover mission).

The Preliminary Design led to the definition of the required DU's main Sub-Systems: Optics, Detector, On-Board Computer & Data-Handling (OBC&DH), Power Distribution and Control Unit (PDCU), Thermal Control System (TCS) and Structure. Considering the extreme temperature conditions, the TCS is constituted by 2 layers of Multi-layer Insulation (MLI), a radiator and thin heaters, while the main structure is made of Aluminium-Titanium based frames and Acrylonitrile Butadiene Styrene 3-D printed panels reinforced with carbon fiber. A Centralized PDCU architecture provides the subsystems with the required power to operate in each mission phase. Moreover, a single fault tolerant avionics module is implemented using a Field Programmable Gate Arrays (FPGA) capable of controlling the acquisition mechanisms and the calibration devices.

This paper presents MIMESiS' design drivers, the feasibility analysis of the mission and the preliminary technical development of each subsystem, mainly using Commercial-off-the-shelf (COTS) components to guarantee a sufficiently high Technology Readiness Level (TRL).