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A MODULAR SPACE MISSION ARCHITECTURE FOR SMALL SATELLITE EARTH OBSERVATION MISSIONS.

Abstract

Small satellite missions offer the opportunity of cheaper and more frequent Earth Observation (EO) data. More than 1,000 Cubesat missions have been launched over the past 7 years, EO being the main contributor. These missions have seen improvement on the main mission segments. Satellites have increased in performance (size, mass, power, pointing accuracy and downlink capacity). Launch services now provide affordable and available deployments to orbit (Nanoracks since 2013 from the ISS, 2018 Small launcher by Rocket Lab, 2019 Small launch programme from SpaceX). Ground stations infrastructure at different latitudes is now accessible through providers like Leaf Space, Swedish Space Corporation or Amazon Web Services. Earth Observation can now benefit from modular space mission architectures that incorporate the advantages of all these segments. This paper presents the advantages and limits of modular space mission architecture applied to a remote sensing and a scientific mission. The first part will present the generic mission architecture used as a baseline for these missions. This will include the project, commercial and technical perspectives of a mission together with the rationale for identifying which parts are considered standards and others flexible from one mission to another. The second part will describe how this structure is used for the MANTIS mission: a 12U Cubesat mission delivering 2.5m resolution in 4 bands (RGB and NIR). This mission uses a novel binocular camera which imposes specific constraints in terms of micro-vibration, pointing accuracy and data downlink capabilities. The mission is at CDR maturity co-funded through the Incubed programme and is planned to launch at beginning of 2022. The third part continues by applying this structure to the NanoMagSat 3x16U Cubesat constellation mission to monitor the Earth magnetic field and ionospheric environment. This mission features 4 payloads with specific requirements on the Electromagnetic Compatibility requiring specific adaptations of the AOCS and the use of a deployable boom, it is at PRR maturity and has been shortlisted as one of the Scout missions by ESA. A final part will summarise the lessons learned, analyse and conclude as to the potential use of this modular architecture for future EO missions in thermal infrared and hyperspectral.