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MSR RENDEZVOUS AND CAPTURE PHASE: THE GNC SUBSYSTEM SOLUTION AND A SNAPSHOT OVER THE IMAGE PROCESSING ALGORITHMS AND NARROW ANGLE CAMERA ELEGANT BREADBOARD

Abstract

Mars Sample Return (MSR) mission, jointly run by the European Space Agency and NASA, aims at making further headway in the exploration of Mars, bringing Martian soil samples back to Earth. Running from 2020 to 2030, the international mission will foresee three launches from Earth and one more rocket lift-off from Mars, with the purpose of collecting Martian soil samples, storing them in an orbiting sample container (OS) and bringing them back to the Earth, where a team of international scientists will be able to perform analysis otherwise not possible on Mars with the current technology.

One of the most critical and focal phases of the mission is the Rendezvous and Capture, during which the MSR Earth Return Orbiter spacecraft (MSR-ERO) will track the Orbiting Sample (previously released in Martian orbit by a Mars Ascent Vehicle), will estimate its orbit and will perform all the manoeuvres needed for approaching and capture it. In the scope of the rendezvous and capture phase, GMV has developed the GNC and the Image Processing algorithms for OS detection and orbit determination at long range and short range. Additionally, GMV also bread-boarded the Narrow Angle Camera (NAC) which will be used to acquire the optical images needed to test the abovementioned OS orbit determination. The IP algorithms have been integrated into an electronic HW platform composed by an Image Processing Board Engineering Model (IPB-EM) and a NAC Camera Optical Unit Elegant Breadboard (NAC COU-EBB), which has been used to validate the system in Hardware-in-the-Loop (HIL) optical and dynamic mission-representative environments up to TRL 6.

This paper will present the Rendezvous and capture GNC subsystem solution, with particular details on the IP algorithms implementation and validation, the NAC EBB architectural and detailed design and the main results obtained during the HIL test campaigns. These results have been used to provide inputs

to MSR-ERO system study, importantly supporting so the definition of the upcoming MSR mission.