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DEVELOPMENT AND VALIDATION OF GNC FUNCTIONAL MODES FOR ASTEROIDS SAMPLE RETURN MISSION IN THE FRAME OF THE EUROPEAN COMMISSION H2020 NEOSHIELD-2 PROJECT

Abstract

The European Union HORIZON 2020 project NEOShield-2 aims at developing and maturating the necessary technologies for NEO objects characterization and deflection space missions, as well as performing a comprehensive research and characterization of the 50-300m diameter NEO population. In the frame of the development of GNC techniques for spacecraft (S/C) operation at close proximity to small asteroids, GMV's responsibility is the development and validation of an autonomous vision-based GNC system of a Sample-Return mission, which main goal is the control of the spacecraft trajectory during the descent and landing on the asteroid. The project consisted in the development of GNC and Image Processing (IP) algorithms and their validation in several environments in order to gain representativeness and raise their Technology Readiness Level (TRL). A step-wise and incremental approach has been followed, first the GNC and IP have been developed and validated in Model In-the Loop environment, then they have been embedded in space representative processors for performing the Processor-in-the-Loop (PIL) in which the system performances are validated in real time; in this stage it has been evaluated the computational performances of the system and the need of HW acceleration in a dedicated FPGA for the IP (in order to cope with the challenging update frequency of 1 Hz) has been identified. Finally, the descent and landing GNC mode has been tested in two HW-in-the-Loop (HIL) facilities in which the HW models of the most critical sensors are added to the PIL equipment: a first step performed in GMV's Optical Laboratory in which a space representative camera is used for feeding the IP and it is stimulated by an optical stimulator; a second step in the platform-art© robotic testbed, in which also a laser altimeter is added, both sensors are moved by a robotic arm which reproduces the spacecraft trajectory and are stimulated by an asteroid mock-up. These last HIL validation campaigns allowed to

verify that the system is robust to the use of real HW sensors and is intended to reach a final TRL of at least 5 (as per ISO 16290:2013, tailored in the scope of the project). Airbus DS Germany, as coordinator of the NEOShield-2 consortium acted as GNC technology development and validation guidance authority by defining reference mission scenario and requirements; also acted as independent system performance evaluator and will assess the TRL of the GNC-IP based functional GNC modes achieved at the end of the activity.