SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)

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AIM VISION BASED GNC

Abstract

The Asteroid Impact Mission (AIM) is a small ESA mission of opportunity which objective is to perform scientific observations of a binary asteroid (Didymos) while demonstrating technologies for future missions and addressing planetary defense. The distance to the Earth during the proximity operations and the binary system characteristics, together with the expected navigation performance, are the main reasons that push the AIM mission towards a high level of autonomy during critical phases. Probably one of the main challenges for the AIM mission, is the delivery of the MASCOT-2 lander on the surface of the secondary asteroid. This payload will be released from the AIM spacecraft at a short distance from the surface, requiring advanced and complete on-board autonomy (speaking about Guidance, Navigation and Control algorithms). This can be achieved thanks to vision based navigation that provides high accuracy relative measurements with respect to the asteroid. The objective of a AIM parallel activity run by GMV, was to perform hardware-in-the-loop (HIL) validation tests with a HW representative of a true navigation camera, the NPAL bread board. The activity also assessed the possibility of re-using the GNC system designed and developed for the Marco-Polo R mission to the AIM mission, showing that the system, once tailored to the specific needs of the mission, is able to fulfill the strict requirements of the AIM mission. HIL tests have been performed in two different facilities at GMV premises, the optical laboratory and the platform-art robotic facility. The HIL validation result showed that the performances obtained in the HIL tests are really consistent with the ones expected from the model-in-the-loop (MIL) validation, thus demonstrating that the GNC system (including the image processing) is robust to the use of a space-representative navigation camera. The limited equipment available on-board forces some innovative data fusion strategies in order to perform the GNC tasks to achieve the mission objectives and for the FDIR to perform independent validation of the GNC performances and assure safety of the operations. In the current baseline the most challenging aspect of the MASCOT-2 release is the lack of a direct range measurement available for the nominal GNC loop due to mass/budget trade-off (and low TRL level of on-board instruments which are considered experiments). This strategy requires an accurate navigation initialization from ground and a reduced autonomous phase not to accumulate a significant navigation error that may jeopardize the MASCOT-2 landing conditions.