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HERA GNC SUBSYSTEM FOR DEEP SPACE AND ASTEROIDS PROXIMITY OPERATIONS

Abstract

HERA is a European mission of opportunity in the frame of planetary defence, with the main objective of demonstrating the kinetic impactor technique on a binary asteroid system. It is based on extensive work done by the European Space Agency and European industry between 2011 and 2016 (AIM studies in the frame of the AIDA joint mission with NASA). After the interplanetary cruise, the HERA spacecraft will go through the close proximity operation phase in which the distance to the binary asteroid system will be progressively reduced. Small distances are necessary for a deep investigation of the crater formed as a consequence of the DART spacecraft impact (from NASA) on the Moon of the binary system, Didymoon. A GNC system for the close proximity operations is being designed with increasing levels of autonomy to perform different technology demonstrations. As it is the first time that a binary asteroid system will be studied from short distance, it is also important to remark that the autonomous GNC will increase significantly the scientific return of the mission. The HERA phase B1 is led by OHB System and GMV Spain is responsible for Mission Analysis and GNC, leading a European consortium composed by GMV subsidiaries from Romania, Poland and Portugal together with Spinworks and OHB Sweden. With respect to AIM, a delta development of the main GNC functions has been performed and tested in order to increase the robustness and the TRL of the autonomous solution (Hardware-In-the-Loop tests will allow the technology to achieve a TRL 6 by the end of 2019). OHB Sweden is responsible for the ADCS (Attitude Determination and Control System) design which is based on their extensive previous experience. GMV group consolidated the mission analysis, improved the autonomous navigation estimation filter using different image processing and performing data fusion with payload (e.g. laser altimeter and thermal camera). An ad-hoc solution has been implemented also for one of the two HERA interplanetary cubesats (Juventas) for which GMV Romania is the GNC responsible in the phase A contract led by GOMspace. This paper will include a description of the design of the vision-based HERA GNC subsystem, together with the justification of the required autonomy and the test campaign results. The paper will focus on the Image Processing (centroiding and feature tracking) and GNC functions, including the dedicated solution for the Juventas interplanetary cubesat.