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JUVENTAS CUBESAT IN SUPPORT OF HERA MISSION TO DIDYMOS ASTEROID SYSTEM: TEST-DRIVEN IMPLEMENTATION

Abstract

Juventas is one of the two CubeSats travelling to the Didymos binary asteroid system onboard Hera, The European Space Agency's planetary defense mission. As one of the first deep space CubeSats, Juventas is meant to contribute to the asteroid research and mitigation assessment objectives of the Hera mission, thanks to two main instruments: the Juventas Radar (JuRa) and a gravimeter (GRASS).

Juventas relies on the Hera spacecraft for its operations, with all communications between itself and its ground operators relayed through Hera in a bent-pipe architecture, with the Inter-Satellite Link (ISL) as unique channel. A dedicated CubeSat Mission Operations Centre (CMOC) will be the focal point for all Juventas operations and will be in charge of commanding, monitoring health & telemetry, mission planning of future observation sequences, and flight dynamics activities to reconstruct past orbits and size manoeuvres. The existence of this Hera relay and the overall operation architecture have impacts on the autonomy level required by the CubeSat but also on the turnaround time to the ground with certain effect on mission planning. For these reasons, the careful development of the operational procedures and their validation are keys to mission success.

This paper will describe the different mission phases and the undertaken activities in these phases, focussing on the concept of operations which relies on the Hera mothercraft as a relay to ground. First, the mission phases are broken down into operational scenarios which can be run several time throughout the mission. Those scenarios and the use cases that compose them are used for the system design, from power and data budgets to thermal analysis and energy budget. In a second time, those use cases and operational scenarios are used to develop the on-board software as well as the operational procedures which are partially onboard and partially on ground. Finally, all these procedures are tested on different intermediary models (FlatSat, Engineering Model) in order to perform functional tests, increase confidence in the system design, verify requirements but also validate the Fault Detection, Isolation and Recovery (FDIR) strategies and autonomy features. The iterative process centered around such a test-driven approach and the different lessons learned that were gathered will be presented.

Planned to be launched in 2024 on board Hera, Juventas is developed and assembled by GomSpace Luxembourg acting as a prime integrator and relying on a series of industrial and academic partners for the different payloads and subsystems.