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HERMES CONSTELLATION: A NEW PARADIGM FOR MULTI-MESSENGER ASTROPHYSICS WITH CUBESATS

Abstract

Nowadays the distributed and fractionated systems, very promising to cope with challenging space applications, are eventually moving from their conceptual studies on papers to real implementation for flight, thanks to an increase in TRL for miniaturized components in many crucial technological areas of miniaturized component. HERMES scientific constellation, currently in its phase D, falls in those missions' category: the project – financed by the Ministry of Italian Research and by an EC H2020 project - aims of implementing the multi-messenger astrophysics paradigm and detecting the electromagnetic counterparts of Gravitational Waves, thanks to miniaturized innovative X-ray detectors distributed on six 3U satellites to fly in formation. The tight scientific requirements imposed to the mission made the HERMES service module and mission operations design and implementation quite challenging: science mode is always active along each orbit, and the payloads shall continuously point towards the same sky region in bunch of three to allows precisely localising the random astrophysics events wherever and whenever they might occur; each space asset, in case of cosmic burst occurrence, shall immediately

transmit data to ground; the fleet shall orbit low in altitude to reduce the scientific payload sensitivity to environmental spurious radiations; a minimum baseline between the spacecraft in a triplet shall be respected to ensure the required level of angular accuracy in the event localisation; last the payload benefits from tight thermal control and its daily data volume is expected to be in the order of 1Gb. To solve each of those challenging requirements, HERMES fleet, not allowed to mount a propulsion in a 3U reduced internal volume, will fly on a low equatorial orbit, exploiting the geopotential effects to ensure triplets of continuously changing satellites experiencing the correct baseline; a set of oversized reaction wheels, supported by magnetotorquers perform the implemented complex pointing control strategy along the mission which keeps at least three payload line of sights aligned for localisation and oriented to maximise the sky visibility; three different communication channels are available on board for fast and heavy data transfer functionalities accomplishment: S and UHF bands, supported by the iridium channel for continuous and fast scientific data link. The on board software is design so that needed mission robustness is ensured. The most performant COTS on market have been selected and are currently under their AIV/AIT process. The paper will discusses the current testing and implementation activities in strong correlation with the overall mission goals.