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EUCLID DARK UNIVERSE MISSION – HIGH STABILITY AND POINTING PERFORMANCE CONTROL

Abstract

Euclid is an ESA medium class cosmology mission dedicated to the investigation of the properties of Dark Energy and Dark Matter. The mission will operate in a large Quasi-Halo orbit around the Sun-Earth Lagrangian point L2 about 1.5 million km away from the Earth. The scientific objectives of this mission impose challenging requirements on the system performances, including a stability relative pointing error (RPE) of 75 milli-arcsec (99.7% confidence level) within a period of 700 seconds.

A dedicated state-of-the-art attitude sensor, the so-called Fine Guidance Sensor (FGS), is developed specifically for this mission, and a Micro Propulsion System (MPS) with variable thrust level in the range of 1N to 1mN is used as actuator to generate the control torques during science. FGS data is combined with high performance gyroscopes and MPS control commands in a state-of-the-art Kalman filter to deliver a very accurate and continuous attitude estimate. STR measurements are also used in a different configuration of a Kalman filter for certain phases.

The reaction wheels (RWLs) are not used during the science observations in order to avoid micro-vibrations, however, they provide a pivotal role as they are used to perform small slews between observation fields. These slew manoeuvres have as distinctive feature that they operate the RWLs under very specific conditions; they are commanded from stand-still and return to stand-still after each slew.

A general overview of the AOCS architecture and design is presented in order to provide the context in which the science is performed, but the paper concentrates on the high performance Science Mode (SCM). The elaborated architecture of the mode is explained, with emphasis on the operation of the various submodes to perform the complex science observation sequences in an autonomous manner. Relevant technical issues will be highlighted and high-fidelity simulations results are shown in this paper.

The Euclid AOCS subsystem has successfully passed the Critical Design Review, thereby demonstrating the achievement of the challenging performance objectives. All the units are now qualified, and the Flight Models ready to be mounted on the spacecraft. SENER is the overall responsible and prime contractor of the Euclid AOCS, with Airbus Defence and Space Netherlands as main partner, while more than 7 additional direct subcontractors are contributing to different components of the subsystem. Thales Alenia Space Italy is Euclid prime contractor and AOCS customer, who also provides the FGS and MPS.