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AOCS SCIENCE MODE DESIGN FOR ESA'S EUCLID MISSION

Abstract

Euclid is a Medium Class mission of the ESA Cosmic Vision 2015-2025 program that has been selected by the ESA's Science Programme Committee for implementation. Its launch in L2 is planned for 2019 on a Soyuz launch vehicle, from Europe's Spaceport at Kourou. Euclid is designed to understand the origin of the Universe's accelerating expansion, mapping large-scale structure over a cosmic time covering the last 10 billion years, more than 75 percent of the age of the Universe. To investigate the nature of dark energy, dark matter and gravity, the mission will target two independent primary cosmological probes: Weak gravitational Lensing (WL) and Baryonic Acoustic Oscillations (BAO). Both probes require the ability to survey a large fraction of the extra-galactic sky, and very high system stability (telescope, focal plane, spacecraft pointing) to minimize systematic effects. The AOCS design drivers are:A) pointing performance and image quality requirements (Relative Pointing Error over 565s less than 20mas, 68percent confidence level); B)minimization of slew time between observation fields to meet the goal of completing the Wide Extragalactic Survey in 6 years. The first driver calls for a Fine Guidance Sensor (FGS) for accurate attitude measurement and actuators with low noise and fine command resolution (Micro Propulsion System, MPS); the second driver requires high torque actuators (Reaction Wheels, RWL) and an extended attitude control bandwidth (Gyroscope, GYR). In the proposed design, both RWL and MPS are used in a synergetic and complementary way during the different operational phases of the science mode. The wheels perform the field slews, whereas during scientific observation they are stopped/locked in order not to perturb the pointing by additional mechanical noise. The MPS maintains the reference attitude with high pointing accuracy during the scientific observation. This innovative solution (called the hybrid solution) achieves both the shortest maneuver times and the pointing performance, with

large mass savings with respect to the "simpler" MPS-only solution. After an overview of the scientific requirements, the spacecraft and the payload, the paper will focus on: 1) AOCS science mode architecture (equipment (e.g. FGS, MPS, RWL), sub-modes organization);2) main aspects of the designed algorithms; 3) simulation results; 4) foreseen actuator additional characterization tests.