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EUCLID FINE GUIDANCE SENSOR: DESIGN AND GROUND VALIDATION

Abstract

The Fine Guidance Sensor (FGS) is the high-precision attitude sensor developed by Leonardo for the Euclid spacecraft that was successfully launched in July 2023. Euclid is a European Space Agency (ESA) survey mission to investigate the nature of dark energy and dark matter by observing the geometry of the Universe through a 1.2 m three-mirror Korsch-type telescope. The scientific objectives require telescope pointing stability of the order of a few tens of milliarcseconds. Extremely accurate pointing performance is achieved through the use of FGS, which provides a very precise attitude measurement to the Attitude and Orbit Control System (AOCS) control loop during science mode. The FGS consists of three electronic sub-modules. Four detectors are used to acquire raw sky images, two Proximity Electronic Modules (PEMs) are used to each operate 2 detectors and to process the acquired sky images, and one Electronic Unit (EU) uses the processed data and a star catalog to calculate accurate pointing information. The FGS focal plane is accommodated in the Payload Module (PLM) next to the instruments focal plane to limit the deformation contributions between the FGS and the instruments field of view. FGS is able to provide an accurate measurement of the attitude change (relative attitude) every 2 seconds with a precision better than 0.03 arcsec (3σ value) around the transverse axes of the telescope. Thanks to a dedicate reference star catalogue, which generation SW has been developed by Leonardo, FGS also provides a very accurate measurement of the absolute attitude every 2 seconds. This article presents the design of the Euclid FGS and the related ground validation processes (both stand alone and integrated on spacecraft) performed by Leonardo. FGS was also tested integrated with other HWs and AOCS by Thales Alenia Space Italy (TAS-I), which is also the Prime Contractor for Euclid mission.