

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

Author: Mr. Roland Le Goff
SODERN, France, roland.legoff@sodern.fr

Mrs. Marie-Christine Arnolfo
SODERN, France, marie-christine.arnolfo@sodern.fr

NAVIGATION CAMERA FOR JUPITER ICY MOONS EXPLORER ESA MISSION

Abstract

The Jupiter Icy Moons Explorer (JUICE) is an ESA mission whose aim is to study the Jovian system: Jupiter itself, its icy moons (Europa, Ganymede and Callisto) and the magnetosphere. For this challenging mission, Sodern was selected to provide the Navigation Camera (NavCam).

NavCam is a key instrument for the spacecraft navigation. During its lifetime JUICE does numerous fly-bys, however the delta V is limited by the available propellant in the spacecraft. To achieve such precise navigation in Jovian environment, ground based radiometric measurements are not sufficient, therefore it is paramount to measure the position of the Jupiter moons in-flight, with high accuracy.

To achieve this measurement, the NavCam assesses the position of the moon and stars in its field of view in an inertial reference frame. The combination of these two measurements gives the accurate position of each of Jupiter icy moons. The stars processing is similar to that of a star tracker and is performed inside the camera, whereas the moons detection is done on-ground from images captured by the camera. In addition to the above primary mission, the navigation camera will also be used by the spacecraft attitude control loop during close fly-bys in order to improve the spacecraft absolute pointing performance.

Jovian environment is particularly severe. The mission profile imposes considerable radiations constraints on the spacecraft, which are uncommon in typical space programs. Jupiter magnetic moment is the largest of the solar system (over 10,000 times higher than the Earth's). It induces a high total dose exposure at electronic parts level (100krad), high number of Single Event Effects and internal charging effects. Furthermore, to achieve the best performances, the NavCam is mounted on the optical bench near sensitive instruments; so it must comply with stringent thermal control and magnetic cleanliness to avoid disturbances to the other instruments. Finally, the measurements of moons and stars in the same field of view induce complex optical design to mitigate stray light.

Star trackers and instrument experience paired with radiation and optical engineering know-how have put Sodern in the position to solve all these challenges.

JUICE NavCam is at the moment at CDR stage with the manufacturing of the engineering model. A successful night sky test has been implemented and used to verify with realistic features the performances. The paper describes the current features and the ongoing model activities.

Keywords: Sodern, ESA, JUICE, Jupiter, Camera, Navigation, star tracker