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SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

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AUTONOMOUS VISION-BASED NAVIGATION FOR JUICE

Abstract

JUICE (Jupiter Icy Moon Explorer) is the first Large Class mission of ESA's Cosmic Vision program, to be launched in 2022. It includes flybys around Europa, Ganymede and Callisto as well as an orbit insertion around Ganymede.

This mission has stringent needs in terms of navigation performance to minimize the propellant budget of stochastic trajectory corrections during the Jovian tour, as well as ambitious pointing accuracy requirements during scientific activities, in particular fly-by closest approaches, phases in which a classical navigation with Doppler measurements and on-ground image processing does not permit to meet the science pointing requirements. Limited ground navigation performance indeed entails a lack of knowledge of the spacecraft position with respect to the science observation targets, hence a large attitude guidance error.

As JUICE prime contractor, and in order to enhance the mission performance in this regard and therefore the science return of the mission, Airbus Defence and Space has designed and is currently implementing a unique autonomous vision-based navigation solution which will adequately complement the capabilities of the ground segment.

This paper first presents how this mission will benefit from a wide experience of Airbus Defence and Space in the field of Vision-Based Navigation, and explains how the implementation of a rather ambitious autonomous image processing (in accordance with classical on-board image processing standards) will help JUICE achieve high precision navigation and pointing.

The Jovian visual environment specificities this image processing will have to face will also be detailed, through the brief assessment of the behaviour of different ground segment image processing solutions in such an environment.

Finally, the overall validation of the on-board vision-based navigation solution is introduced. It will include high-fidelity image simulation with the "Surrender" tool, a close-loop navigation test bench with hardware in the loop and finally real-sky experiments as ultimate validation step before the integration of the navigation camera on the spacecraft.