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SWARM ABSOLUTE SCALAR MAGNETOMETERS FIRST IN-ORBIT RESULTS

Abstract

The ESA Swarm mission will provide the best ever survey of the Earth's magnetic field and its temporal evolution. This will be achieved by a constellation of three identical satellites, launched together on the 22nd of November 2013.

In order to observe the magnetic field thoroughly, each satellite carries two magnetometers: a Vector Field Magnetometer (VFM) coupled with a star tracker camera, to measure the direction of the magnetic field in space, and an Absolute Scalar Magnetometer (ASM), to measure its intensity.

The ASM is the French contribution to the Swarm mission. This new generation instrument was designed by CEA-Leti and developed in close partnership with CNES, with scientific support from IPGP. Its operating principle is based on the atomic spectroscopy of the helium 4 metastable state. It makes use of the Zeeman's effect to transduce the magnetic field into a frequency, the signal being amplified by optical pumping.

The primary role of the ASM is to provide absolute measurements of the magnetic field's strength at 1 Hz, for the in-flight calibration of the VFM. As the Swarm magnetic reference, the ASM scalar performances are crucial for the mission's success. Thanks to its innovative design, the ASM offers the best precision, resolution and absolute accuracy ever attained in space, with similar performance all along the orbit.

In addition, thanks to an original architecture, the ASM implements on an experimental basis a capacity for providing simultaneously absolute vector measurements at 1 Hz. This new feature makes it the first instrument capable of delivering both scalar and vector measurements simultaneously at the same point. Swarm offers a unique opportunity to validate the ASM vector data in orbit by comparison with the VFM's.

Furthermore, the ASM can provide scalar data at a much higher sampling rate, when run in "burst" mode at 250 Hz, with a 100 Hz measurement bandwidth. An analyse of the spectral content of the magnetic field above 1 Hz becomes thus possible.

These different ASM new capabilities have been operated on the three Swarm satellites during the 3-months commissioning phase. The calibration and validation activities are still going on and will last until the end of June 2014. In this paper, we will present and discuss the first results from these various operating modes. From the results obtained in-orbit with the ASM vector mode, we will assess the possible future prospects.