SRAL, A RADAR ALTIMETER DESIGNED TO MEASURE A WIDE RANGE OF SURFACE TYPES

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1. SCOPE

In the context of Global Monitoring for Environment and Security (GMES), the objectives of the Sentinel-3 mission driven by ESA encompass the commitment to consistent, long-term collection of remotely sensed data of uniform quality in the areas of sea/land topography and ocean colour. The Sentinel-3 satellite indeed carries a topography mission including mainly RF instruments and an ocean and land colour mission composed of optical instruments. The aim of this paper is to describe the core instrument of the topography mission [1], the SRAL radar altimeter [2], and its latest development steps.

2. OVERVIEW OF SRAL MISSION REQUIREMENTS

The SRAL (**S**ar **R**adar **AL**timeter) instrument is not only specified to retrieve the classical parameters used in the oceanography field such as the Sea Surface Height (SSH), the Significant Wave Height (SWH) and the sea wind speed but it also makes it possible to perform range measurements over the following surfaces:

- Sea ice
- Ice sheet interiors (e.g. Antartic plateau)
- Ice margins
- In-land waters

To achieve these objectives, SRAL will be supported by the other elements of the topography payload :

- A microwave radiometer which corrects for the tropospheric delay;
- A real-time navigation system implemented by a GPS equipment;
- A Laser Retro-Reflector Assembly to provide calibration of range measurements.

The SRAL mission requirements and the topography payload will be reminded in the first section of this paper.

3. SRAL MAIN FUNCTIONS

SRAL is a nadir-looking radar operating in dual frequency (Ku-band used as main frequency and C-band used for ionospheric corrections over ocean). The nadir swath allows using the simple deramp technique to perform radar pulse compression.

The SRAL instrument includes measurement modes, calibration modes and support modes (stand-by, self-test, etc…). The SRAL measurement modes consist of basic radar modes combined with tracking modes. The conventional Low Resolution Mode (LRM) and the enhanced SAR mode are implemented as radar modes. Each radar mode is operated either in a closed-loop tracking fashion for which the echo is tracked autonomously or in an open-loop tracking fashion by providing a-priori knowledge of the tracking parameters over the targeted spots. Direct transitions between measurement modes, i.e. without going through the stand-by mode, are implemented with optimum transition times which will be presented in the paper.
The calibration modes cover calibration of the inner instrument (transmit chain looped back with receive chain without antenna) and calibration of the gain profile of the range window. A ground transponder will also make it possible to carry out external calibration of the whole instrument (including antenna) throughout nominal measurement modes.

A second section will explain the main features of SRAL and its operating modes.

4. SRAL PERFORMANCES

The key performance parameters of the instrument (Signal to Noise Ratio, altimetric range accuracy, impulse response, radiometric accuracy, ground resolution) will be presented in the third section of this paper. The most up to date evaluation of these parameters provided by simulation or measurements will be explained in details.

5. SRAL ARCHITECTURE

A fourth section will provide a detailed overview of the instrument architecture. This will include the redundancy philosophy, the mass/consumption budgets and the split-up in equipments. At last, a status will be given on the latest development steps of the SRAL equipments by focusing especially on the features of the Radio Frequency Unit and the new design proposed for the dual-frequency antenna.

Keywords : SRAL, SAR, radar, altimeter, instrument, architecture, topography, Sentinel-3, oceanography.

Bibliography :

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