

THE SENTINEL-1 C-SAR INSTRUMENT : STATUS AND PERFORMANCE

F. Rostan⁽¹⁾, W. Pitz⁽¹⁾, S. Riegger⁽¹⁾, R. Croci⁽²⁾, R. Torres⁽³⁾

⁽¹⁾ EADS Astrium GmbH, D-88039 Friedrichshafen, Germany

E-Mail : Friedhelm.Rostan@astrium.eads.net

⁽²⁾ Thales Alenia Space Italia, I-00131 Roma, Italy

⁽³⁾ ESA-ESTEC, NL-2201 AZ Noordwijk, The Netherlands

1. INTRODUCTION

‘Global Monitoring for Environment and Security (GMES)’ is a joint initiative of the European Commission (EC) and the European Space Agency (ESA), designed to support Europe’s goals regarding sustainable development and global governance of the environment by providing timely and quality data, information, services and knowledge.

In the frame of the GMES programme, ESA is undertaking the development of the European Radar Observatory Sentinel -1, a European polar orbiting satellite system for the continuation of SAR operational applications. Sentinel-1 is an imaging radar mission in C-band, aimed at providing continuity of data for user services, in particular with respect to the ESA ERS and Envisat missions.

The Sentinel-1 space segment will be designed and build by an industrial consortium with Thales Alenia Space Italia as prime contractor and EADS Astrium GmbH as C-SAR instrument responsible. Phase B2 has started in May 2007 and will be concluded by a Preliminary Design Review (PDR) in May 2008.

2. C-SAR INSTRUMENT DESIGN

The C-SAR instrument for the Sentinel-1 mission is composed of two major subsystems :

- the SAR Electronics Subsystem (SES)
- the SAR Antenna Subsystem (SAS)

The radar signal is generated at baseband by the chirp generator and up-converted to C-band within the SES. This signal is distributed to the High Power Amplifiers inside the EFE Transmit/Receive Modules via the beamforming network of the SAS.

TABLE I. INSTRUMENT KEY PARAMETERS

Parameter	Value
Centre Frequency	5.405 GHz
Bandwidth	0 ... 100 MHz (programmable)
Polarisation	HH-HV, VV-VH
Antenna Size	12.3 m x 0.84 m
RF Peak Power (sum of all EFE TRMs, at TRM output)	4368 W
Pulse Width	5-100 us (programmable)
Transmit Duty cycle	12 % max
Receiver Noise Figure at Module Input	3 dB
Pulse Repetition Frequency	1000- 3000 Hz (programmable)
Data Compression	Selectable according to EC-BAQ

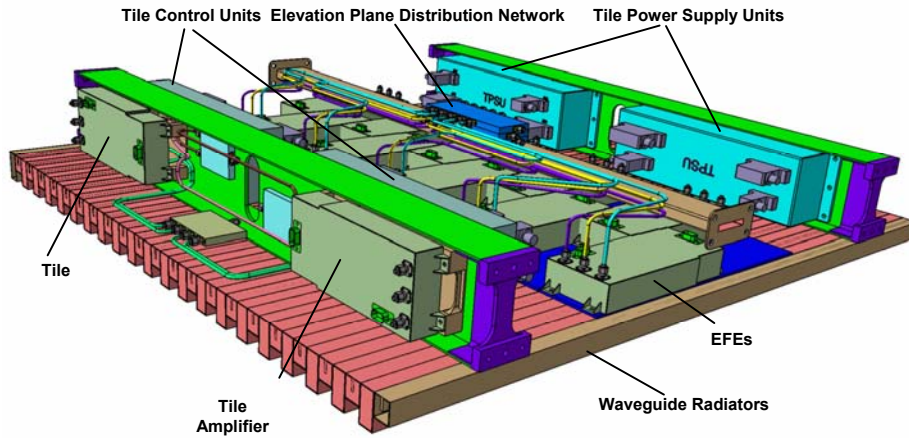


FIGURE I THREE-DIMENSIONAL VIEW OF THE SAS TILE LAYOUT

Signal radiation and echo reception is realized with the same antenna using slotted waveguide radiators. In receive, the echo signal is amplified by the low noise amplifiers inside the EFE Transmit/Receive Modules and summed up using the same network as for transmit signal distribution. After filtering and down conversion to baseband inside the SES, the echo signal is digitised and formatted for recording. Table 1 provides a brief overview on the instrument key parameters. A three-dimensional view of the SAS Tile, which is the elementary building block of the SAR Antenna Subsystem, is given in Fig. 1.

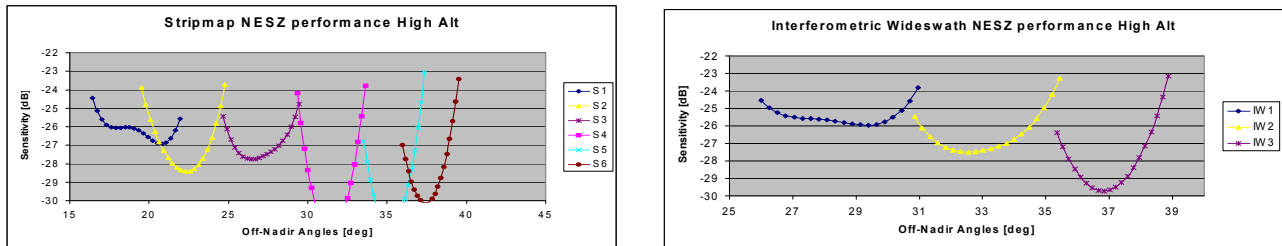


FIGURE II NOISE EQUIVALENT SIGMA ZERO (NESZ) FOR STRIPMAP AND INTERFEROMETRIC WIDESWATH MODE

The presentation will give an overview on the Sentinel-1 C-SAR instrument and its current programmatic and technical status. After an overview on the instrument design and its key design features, the presentation will conclude with an overview on the predicted instrument SAR performance. An overview on the imaging performance (worst case vs. orbit) is given in Table II. Fig. II provides the NESZ performance a high altitude (725 km) for the 6 swathes of the Stripmap mode and the 3 subswathes of the Interferometric Wideswath Mode.

TABLE II. INSTRUMENT IMAGING PERFORMANCE (WORST CASE VS. ORBIT)

Mode	Pol.	Swath Width	Resolution	Sensitivity NESZ	Ambiguities DTAR
Stripmap	HH-HV, VV-VH	80 km	5 m (range) x 5 m (azim)	-23.1 dB	-22.5 dB
Interferometric Wideswath	HH-HV, VV-VH	250 km	5 m (range) x 20 m (azim.)	-23.2 dB	-22.5 dB
Extrawide Swath	HH-HV, VV-VH	400 km	25 m (range) x 100 m (azim.)	-25.6 dB	-23.1 dB
Wave Mode	HH, VV	20 km x 20 km (Vignette)	20 m (range) x 5 m (azim.)	-24.1 dB	-25.2 dB