TerraSAR-X

Ground Segment

Experimental Product Description

CAF – Cluster Applied Remote Sensing

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DOCUMENT CHANGE CONTROL

Issue	Rev.	Date	Pages	Changes	Status
1.0		16.03.2003	all	Initial issue	
1.1		15.12.2004		Implemented RIDS from CDR and update: - changed RD-RE-TerraSAR-DLR/02 version and made applicable (DCR-0078/WER-R-12) - updated resolution consistently with Hamming window 0,75 / 1.0 - explained product size (PGS-DCR-0052/SCH-N-9) - explained chosen product resolution (DCR-0009/JAC-P-1)	
1.2		05.10.2005	All	Editorial changes References to Level 1b Product Format Specification included	
1.3		06.10.2006		Editorial changes Product table pixel localisation update	

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1 INTRODUCTION

TerraSAR-X is a joint project between the German Aerospace Center (DLR) and the German industry (ASTRIUM). DLR owns and operates the satellite and the payload ground segment (PGS) and holds the rights for the scientific exploitation of the data. ASTRIUM holds the exclusive rights for the commercial exploitation of the data products.

1.1 PURPOSE AND SCOPE

This document complements the Basic Product Specification [R1] with the products of the TerraSAR-X sensor that are stated experimental and therefore not distributed to the public. As shown in Fig. 1 the document is a logical "child" of the Basic Product Specification and contains only relevant differences to it.

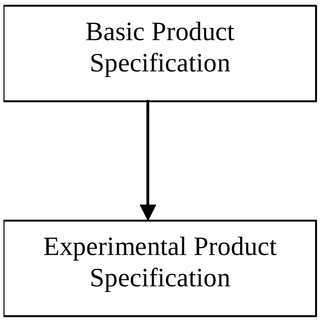

Fig. 1: Structure of PGS Product Specification Documents

Several different classes of products are stated experimental:

Firstly, products derived from experimental sensor modes like the 300 MHz range bandwidth or of the Dual Receive Antenna (DRA) mode where two parallel receive channels are used to record quad polarization SAR signals. Data from both modes are not specified and may therefore have performance parameters that are unspecified or out of bounds.

Secondly, products are stated experimental from a processing point of view because they are either redundant with other products and therefore implemented and tested with low priority (e.g. Twinpol) or they are non-standard products that are more difficult to implement like the complex ScanSAR product.

1.2 DOCUMENTS

The following references are relevant for this document.

1.2.1 APPLICABLE DOCUMENTS

[A1]	TX-PGS-RSD-1005	PGS Requirements Specification Document Issue 2.0
[A2]	RD-RE-TerraSAR-DLR/02	TerraSAR-X Ground Segment Requirements Issue 2.0

1.2.2 REFERENCE DOCUMENTS

[R1]	TX-GS-DD-3302	Basic Product Specification, Issue 1.4
[R2]	TX-AED-TN-0010	TerraSAR-X System Performance Modelling and Analysis Document
[R3]	TX-GS-DD-3307	Level 1b Product Format Specification Issue 1.2

1.3 DOCUMENT OVERVIEW

The present document covers the following aspects:

- chapter 1 defines the term experimental products and lists related documents
- chapter 2 covers general aspects
- chapter 3 lists the experimental products in sub-chapters

2 GENERAL ASPECTS

Ordering and delivery of experimental products may be limited to constrained user groups, e.g. DLR and Infoterra. The procedures and policy are currently not yet defined.

3 EXPERIMENTAL PRODUCTS

In the following the different experimental products are shortly described. Since instrument specifications do not exist for these modes the given parameters are preliminary estimates. The true parameters will be characterized by measurements as soon as the products are available.

3.1 QUAD-POLARISATION PRODUCT

In quad polarization mode the antenna is electrically split into a fore and an aft segment during receive. In both segments different polarizations can be selected. The radio frequency electronics (RFE) and the digital central electronics (DCE) as well as the mass memory (SSMM) are reconfigured to use the secondary (redundant) receiver in parallel and record both antenna channels, i.e. two received polarizations in memory. The number of polarizations is further doubled by doubling the pulse repetition frequency (PRF) and transmitting horizontal and vertical polarization in a pulse to pulse alternating mode like in dual polarization mode. This leads to half the single pol range extent, as for dual pol. Note that incidence angle masks are only supplied with EEC products. MGD and GEC products are approximately 10 % smaller than the given product size.

Mnemonic	{MGD, GEC, EEC}_SE_SM_Q		{MGD, GEC, EEC}_RE_SM_Q		SSC__SM_Q
Imaging Mode	SM				
Product Type	Detected				Complex
Geometric Projection	{MGD, GEC, EEC}				SSC
Polarization Mode	Q				
Resolution Mode	SE		RE		
Number of Polarimetric Channels	4				
Polarization Mode	HH/VV/HV/VH				
Data collection range	15°-60°				
Full Performance range	20°-45°				
Number of Elevation Beams	27				
Range Scene Size [km]	15				
Azimuth scene size [km]	50				
Absolute Radiometric Accuracy [dB]	unspecified				
Relative Radiometric Accuracy	unspecified				
Radiometric Stability [dB]	unspecified				
NESZ [dB] 4)	unspecified				
DTAR [dB] 1)	unspecified				
PSLR [dB] 2)	unspecified				
ISLR [dB] 3)	unspecified				
Inc. Angle Masks	1				0
Bit per Pixel	16				32
Hamming coefficient	0,75				1,00
Incidence angle (20°-45°)	20	45	20	45	
Slant range resolution [m]					1,9
Ground Range Resolution [m]	6,6	6,6	16,6	11,7	
Azimuth Resolution [m]	6,6	6,6	16,6	11,7	6,6
Range Pixel Spacing [m]	3	3	9	6	1,3
Azimuth Pixel Spacing [m]	3	3	9	6	2,5
Effective number of looks	1,0	2,1	6,5	6,6	
Pixel localization accuracy [m] 5)					2,0
Radiometric resolution [dB]	3,1	2,4	1,5	1,5	
Product Size (MB)	833	833	93	208	3576

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Table 3-1: Table of quad polarization products, samples for 20° and 45°

3.2 TWIN POLARIZATION PRODUCT

In twin polarization mode two polarization channels are derived by operating the instrument in a ScanSAR like mode, but changing the polarization instead of the elevation beam. The disadvantage compared to dual polarization mode is that the spectra of the two polarization channels are not phase coherent and may show ScanSAR specific scalloping artefacts if e.g. the Doppler centroid or the azimuth antenna patterns are not precisely known. The advantage of the twin polarization mode is that the PRF has not to be doubled as in dual polarization mode. For that reason, the swath width is the full stripmap swath.

The azimuth resolution of twin pol mode is assumed to be twice as good as the ScanSAR resolution, i.e. 8 meters. Due to the chosen product design strategy a square resolution cell between 13.5 m and 9.5 m for incidence angles between 20° and 45° is selected. The slant range resolution is assumed to be 1.0 meters as for stripmap mode. Like for the basic products from ScanSAR mode, only detected products are available.

Note that incidence angle masks are only supplied with EEC products. MGD and GEC products are approximately 20 % smaller than the given product size.

Mnemonic	**{MGD, GEC, EEC}_RE_SM_T**	
Imaging Mode	SM	
Product Type	Detected	
Polarization Mode	T	
Geometric Projection	{MGD, GEC, EEC}	
Resolution Mode	RE	
Number of Polarimetric Channels	2	
Polarization Mode	HH/VV	
Data collection range	20°-60°	
Number of Elevation Beams	27	
Full Performance range	20°-45°	
Range Scene Size [km]	30	
Azimuth scene size [km]	50	
Absolute Radiometric Accuracy [dB]	unspecified	
Relative Radiometric Accuracy	unspecified	
Radiometric Stability [dB]	unspecified	
NESZ [dB] 4)	unspecified	
DTAR [dB] 1)	unspecified	
PSLR [dB] 2)	unspecified	
ISLR [dB] 3)	unspecified	
Inc. Angle Masks	1	
Bit per Pixel	16	
Hamming coefficient	0,75	
Incidence angle (20°-45°)	**20**	**45**
Ground Range Resolution [m]	13,5	9,5
Azimuth Resolution [m]	13,5	9,5
Range Pixel Spacing [m]	7	5
Azimuth Pixel Spacing [m]	7	5
Effective number of looks	6,5	6,6
Pixel localization accuracy [m] 5)		
Radiometric resolution [dB]	1,5	1,5
Product Size (MB)	184	360

Table Version 7.8.06 13:56

Table 3-2: Table of twin polarization products, samples for 20° and 45

3.3 Complex ScanSAR Product

The complex ScanSAR product is intended for ScanSAR interferometry. Apart from a complex product, ScanSAR interferometry requires that both images have a common Doppler spectrum, i.e. they are acquired from the same squint angle and the bursts are synchronized in time. The common Doppler bandwidth is guaranteed by the improved zero Doppler steering implemented in the satellite. The timing condition can be achieved by using a special feature of the TerraSAR-X satellite: it has the capability to start an imaging acquisition triggered by GPS position and can therefore achieve burst patterns that are synchronized in time and Doppler frequency.

Mnemonic	**SSC__SC_S**
Imaging Mode	SC
Product Type	Complex
Polarization Mode	S
Geometric Projection	SSC
Resolution Mode	
Number of Polarimetric Channels	1
Polarization Mode	{HH, VV}
Data collection range	20°-60°
Number of Elevation Beams	27
Full Performance range	20°-45°
Range Scene Size [km]	100
Azimuth scene size [km]	150
Absolute Radiometric Accuracy [dB]	unspecified
Relative Radiometric Accuracy	unspecified
Radiometric Stability [dB]	unspecified
NESZ [dB] 4)	unspecified
DTAR [dB] 1)	unspecified
PSLR [dB] 2)	unspecified
ISLR [dB] 3)	unspecified
Inc. Angle Masks	0
Bit per Pixel	32
Hamming coefficient	1,00
Slant Range Resolution [m]	1,0
Azimuth Resolution [m]	16,0
Range Pixel Spacing [m]	0,8
Average Azimuth Pixel Spacing [m]	13
Effective number of looks	1,0
Pixel localization accuracy [m]	2,0
Radiometric resolution [dB]	3,1
Product Size (MB)	5940
Table Version	7.8.06 13:56

Table 3-3: Preliminary parameters of complex ScanSAR product

The data structure of a complex ScanSAR product is more complicated because of varying PRFs between the beams, non-coherent sampling grids between the bursts of one beam. The focussed Data from each beam are stored in one individual file. Each beam file contains the focussed bursts together with their image raster coordinates. The format is described in [R3]. It is a compact format and the user can extract and work with the individual bursts for the purpose of SAR interferometry.

- Last page of Experimental Product Description –