

Fully Polarimetric TerraSAR-X Data: Data Quality and Scientific Analysis

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Abstract

In this paper the acquired data of the experimental fully polarimetric mode of TerraSAR-X are investigated in terms of data quality and the potential to use polarimetry at short wavelength. In spring 2009 the dual receive antenna was switched on for three data acquisition cycles collecting fully polarimetric data over varying natural scenes. The focus of this paper is to investigate the quality of these scenes and provide some insight into using fully polarimetric data for bio/geophysical parameter estimation.

1 The TerraSAR-X Mission

TerraSAR-X is the first German Radar satellite for scientific and commercial applications. The project is a public-private partnership between DLR and EADS Astrium GmbH. TerraSAR-X consists of a high resolution Synthetic Aperture Radar at X-Band. The radar antenna is based on active phased array technology that allows the control of many different instrument parameters and operational modes (Stripmap, ScanSAR and Spotlight) with various polarizations. The TerraSAR-X launch was the 15 June 2007. Only 4 days later the first image was delivered. The variety of TerraSAR-X polarization modes is reviewed and validation results of each mode are presented. The polarization modes include operational modes like dual-pol in Stripmap and Spotlight. Additionally there are experimental modes like twin polarization mode which is similar to the ASAR alternating polarization mode, or the full polarimetric mode which is realized in the TerraSAR-X Dual Receive Antenna configuration. The Dual Receiving Antenna Mode (DRA) of TerraSAR-X offers a high variety of interesting applications and experiments, e.g. along track interferometry, geometric resolution enhancement and especially the full polarimetric mode. In the DRA mode of TerraSAR-X, the complete antenna is used for transmission but in receive, the antenna is divided into two separate partitions in along track. The signals of both receiving antennas are recorded separately by exploiting the redundant receiver chain of the instrument. Both signals are not recorded separately but as sum and difference signal. This demands for special calibration in the reconstruction of fore and aft channel before SAR processing and has influence on the polarimetric performance.

2. The Fully Polarimetric TerraSAR-X Campaign

The TerraSAR-X fully polarimetric campaign was conducted in April to May 2009 acquiring coherent X-band fully polarimetric data over selected natural scenes being already investigated using longer wavelength multi-parametric airborne SAR data. The selected scenes

containing natural scenes from boreal forest, tropical forest, agricultural site, open ocean and snow/ice area.

3. Data Analysis

A theoretical background is provided to the expected polarimetric signatures in X-band and is compared to the obtained parameters derived from TerraSAR-X. Important polarimetric parameters that will be used for comparison are polarimetric ratios, polarimetric coherences, statistical parameters as the polarimetric entropy and alpha angle. An outlook to the potential of bio-/geophysical parameter estimation from fully polarimetric TerraSAR-X data is given.

References

[1] www.dlr.de/tsx/