SINGLE PASS X-BAND SAR INTERFEROMETRY FOR FOREST PARAMETER ESTIMATION: A FIRST ASSESSMENT OF THE TANDEM-X POTENTIAL

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1. INTRODUCTION

The focus of this paper is on the science product exploration of the TanDEM-X mission with respect to forest parameter estimation and mapping. After the successful launch and operation of TerraSAR-X (TSX), data product simulation and performance investigation for the TanDEM-X (TDX) become major issues for further investigations. Already, several simulations of TDX data products have been performed using the DLR's E-SAR airborne X-band SAR system, especially with respect to HRTI-3 DEM generation. In this paper we focus on the estimation of forest height using dual-baseline single pass SAR interferometry, assess the inversion performance, and project onto the TDX mission parameters [1]. Further, the trade-off between fully (i.e. quad) and dual polarimetric parameter inversion performance is discussed.

2. THE MISSION TANDEM-X

TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurement) opens a new era in spaceborne radar remote sensing. A single-pass X-band SAR interferometer with adjustable baselines in across- and in along-track directions is formed by adding a second, almost identical spacecraft (TDX) to TerraSAR-X (TSX) and flying the two satellites in a closely controlled formation. TDX has SAR system parameters which are fully compatible with TSX, allowing not only independent operation from TSX in a mono-static mode, but also synchronized operation (e.g. in a bi-static mode). With typical across-track baselines of 200-400m DEMs according to the High Resolution Terrain Information (HRTI) 3 standards will be generated. The HELIX concept provides a save solution for the close formation flight with vertical separation of the two satellites over the poles and adjustable horizontal baselines at the ascending/descending node crossings.

DEMs are of fundamental importance for a broad range of scientific and commercial applications. For example, many geoscience areas like hydrology, glaciology, forestry, geology, oceanography and land environment require precise and up-to-date information about the Earth's surface and its topography. Digital maps are also a prerequisite for reliable navigation, and improvements in their precision needs to keep step with the advances in global positioning systems. Beyond the generation of a global HRTI-3 DEM as the primary mission goal, local DEMs of even higher accuracy level (HRTI-4) and applications based on Along-Track Interferometry (ATI) like measurements of ocean currents, sea ice drift and glacier flow are important secondary mission objectives. Along-track interferometry will also allow for innovative applications to be explored and can be performed by the so-called dual-receive antenna mode on each of the two satellites and/or by adjusting the along-track distance between TSX and TDX to the desired value. Combining both modes will provide a highly capable along-track interferometer with four phase centers. The different ATI modes will e.g. be used for improved detection, localisation and ambiguity resolution in ground moving target indication and traffic monitoring applications. Furthermore, TanDEM-X supports new SAR techniques, with focus on multi-static SAR, polarimetric SAR interferometry, digital beam forming and super resolution [2],[3].

The TDX spacecraft will be as much as possible a re-build of TSX with only minor modifications like an additional cold gas propulsion system for constellation fine tuning and an additional S-band receiver to enable a reception of status and GPS position information broadcast by TSX. This guarantees a low development risk and it offers the possibility for a flexible share of operational functions for both the TerraSAR-X and TanDEM-X missions among the two satellites. The TDX spacecraft will be designed for a nominal lifetime of 5 years and has a nominal overlap with TSX of 3 years. TSX holds consumables and resources for up to seven years of operation, allowing for a potential prolongation of the overlap and the TanDEM-X mission duration. The launch of the TDX spacecraft is planned for autumn 2009.

3. REFERENCES

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