Processing System and Algorithms for the TanDEM-X Mission

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In 2009, the German radar satellite TerraSAR-X will be supplemented with the TanDEM-X satellite to form the first bi-static single pass interferometer in space. TanDEM-X will fly close to TerraSAR-X in a controlled helix configuration for 3 years to jointly acquire interferometric SAR data in bistatic mode. The primary TanDEM-X mission goal is to derive a global Digital Elevation Model (DEM) with an accuracy corresponding to HRTI-3 specifications (2 m relative point-to-point height accuracy for moderate terrain at 12 m posting). Additionally, experiments such as along track interferometric mode or large baseline interferometry will be carried out.

Even today, first interferometric processing results from TerraSAR-X repeat-pass acquisitions impressively demonstrate the DEM accuracy that can be achieved from metric resolution X-band data. They also confirm the suitability of the phase preserving focussing algorithms, the successful migration of the InSAR algorithms from SRTM to the new challenging TerraSAR-X domain (requiring e.g. terrain dependent co-registration) and the stability of the instrument.

According to the current TanDEM-X mission concept, there will be at least two complete coverages of the global land surface, each one lasting one year. The two coverages will have different heights of ambiguity to allow multi-baseline phase unwrapping. Finally difficult

terrain will be covered again with different acquisition geometries (i.e. different look direction and/or incidence angles). To achieve the required accuracy and for the sake of a homogenous

data quality the acquisitions from different mission phases will be fused into the final global DEM. The mission is complemented by experimental acquisitions in different cooperative modes (e.g. alternating bistatic mode).

Besides the high data volume and throughput requirements, the operational processing chain has to meet the challenges of combining acquisitions from different mission phases, which are downlinked in segments over widely distributed remote ground stations and yet to provide a fast feedback on interferometric data quality for (re-)acquisition planning well ahead of flight formation changes. The design presented here meets these challenges with a consistent systematic and data driven processing approach. It follows a unified way for the generation of the global DEM, customized DEMs and most of the experimental products.

This paper outlines the planned SAR data workflow from screening over bistatic focussing and interferometric processing to raw DEM generation. It addresses some aspects of the InSAR processing algorithms which exploit the synergies of bistatic focussing and interferometric processing parameter calculation. Intermediate complex image products are introduced for the evaluation of experimental modes. Emphasis is laid on results of studies on the robustness and performance of multi-baseline phase unwrapping and DEM reconstruction algorithms foreseen for the TanDEM-X data processing.