TanDEM-X Mission Overview

Manfred Zink

Primary Mission Objective

- The main goal of the TanDEM-X mission is the generation of a world-wide, consistent, timely and high-precision digital elevation model (DEM) according to the HRTI-3 standard
- Additionally, DEMs with HRTI-4 standard will be locally generated (e.g. crisis management support)
Secondary Mission Objectives

New SAR Techniques

- Bi-Static SAR
- InSAR Processing
- Super Resolution

Along-Track Interferometry

- Ocean Currents
- Traffic Monitoring
- Glacier Mass Balance
- Digital Beamforming

Secondary Mission Objectives

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Ocean Currents

Traffic Monitoring

Glacier Mass Balance

Digital Beamforming
TerraSAR-X Operational Modes

Strip Map Mode
Resolution: 3 m x 3 m, Scene Size: 30 km x 100 km

Scan SAR Mode
Resolution: 16 m x 16 m, Scene Size: 100 km x 100 km

Spotlight Mode
Resolution: 1 x 1.5 m ... 3.5 m, Scene Size: 5 ... 10 km x 10 km

Experimental Modes:
- Dual-Phase-Center Antenna
- Split in Azimuth
- DRA Mode
  - full polarimetric
  - along-track interferometry (traffic products)

First Satellite Mission in "Close Formation Flight"

- Innovative HELIX orbit concept
- Reduced collision risk - no crossing of single orbits
- Variation of baselines in cross track and along track easily achievable
- Orbit-/Helix position to be considered in mission planning
- Baseline determination to mm-accuracy (TOR)
Bi-static Operation - Synchronisation

- Bi-static operation of TSX and TDX requires synchronisation of independent oscillators
- Necessary hardware modifications already implemented on TSX
- Novel operational modes to be defined
- Complex procedures for instrument commanding
- Continuous in-flight characterisation of oscillator drift
- Additional “pre-processing” steps

Mission Planning

- Acquisition of HRTI-3 DEM in 3 years requires globally oriented acquisition strategy
- Disturbance of TerraSAR-X mission to be minimised
- Systematic acquisition of TanDEM data in long strips of typically 1000km
- Orbit/Helix position to be taken into account – mission scenario, interference
Data Volume

- Data volume (raw data) of 328 TB
- Neustrelitz has no free capacity beyond TerraSAR-X
- Minimum network of 3 ground stations (Kiruna, O'Higgins, ASF)
- In total 600 TB to be processed and archived (additional archive required for interferometric processing)
- Global (level-3) product

Calibration

- Small errors in baseline geometry or instrument phase variations cause considerable height errors
- Error characterisation and simulation ⇒ mission scenario (e.g. number and spacing of crossing orbits)
- Operational implementation in the frame of the global DEM mosaicking process
- Reference height data of sufficient quality required globally (e.g.: GPS-Tracks, laser altimeter, ocean surface height models, etc.)
TanDEM-X Mission Team

- Overall Management by German Space Agency (DLR)
- German Aerospace Center (DLR)
  - Microwaves and Radar Institute (HR)
  - Remote Sensing Technology Institute (IMF)
  - German Remote Sensing Data Center (DFD)
  - German Space Operation Center (GSOC)
- EADS Astrium GmbH
- Infoterra GmbH
- GeoForschungsZentrum Potsdam (GFZ)
- NASA/JPL contribution of secondary payload is under discussion

TanDEM-X Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2003</td>
<td>German Call for Proposals for a Future Earth Observation Mission</td>
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<tr>
<td>2004</td>
<td>Selection of TanDEM-X for Phase A Study</td>
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<tr>
<td>2005</td>
<td>Phase A Study</td>
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<tr>
<td>2006</td>
<td>Final Decision</td>
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<td>2007</td>
<td>Phase B/C/D</td>
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<td>2008</td>
<td>TanDEM-X Operation</td>
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<tr>
<td>2009</td>
<td>TerraSAR-X Operation</td>
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<tr>
<td>2010</td>
<td>At least 3 years of joint operation</td>
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<tr>
<td>2011</td>
<td></td>
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in der Helmholtz-Gemeinschaft