TanDEM-X: Mission Status & Scientific Contribution

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TanDEM-X: TerraSAR-X-Add-on for Digital Elevation Measurements

Launch: 21.June 2010 (38 days ago) from Baikonor (first signal arrived from the ground station Troll in the Antarctic after 15 min)
Standards for Digital Elevation Models (DEM)

<table>
<thead>
<tr>
<th>DEMs</th>
<th>Spatial Resolution</th>
<th>Absolute Vertical Accuracy (90%)</th>
<th>Relative Vertical Accuracy (point-to-point in 1° cell, 90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTED-1</td>
<td>90 m x 90 m</td>
<td>&lt; 30 m</td>
<td>&lt; 20 m</td>
</tr>
<tr>
<td>DTED-2</td>
<td>30 m x 30 m</td>
<td>&lt; 18 m</td>
<td>&lt; 12 m</td>
</tr>
<tr>
<td>TanDEM-X DEM</td>
<td>12 m x 12 m</td>
<td>&lt; 10 m</td>
<td>&lt; 2 m</td>
</tr>
<tr>
<td>HDEM</td>
<td>6 m x 6 m</td>
<td>&lt; 5 m</td>
<td>&lt; 0.8 m</td>
</tr>
</tbody>
</table>

Primary Mission Objectives

- **Across track InSAR (Digital Elevation Model)**
  - Development & improvement of algorithm for validation of heights derived from InSAR; Input parameter for a variety of different applications
  - Added values and generation of scientific products

- **Along track InSAR (Velocity Measurements)**
  - Exploitation of innovative applications and development of algorithm
  - New application and scientific product development

- **New SAR Techniques (First Technical Demo.)**
  - Demonstration and exploitation of new SAR techniques
  - New perspectives for future SAR systems and development of new applications

Secondary Mission Objectives
**Capabilities of TanDEM-X**

**Cross-Track Interferometry**
- Digital Elevation Models
- Spatial Coherence (forest, ...)
- Double DInSAR (change maps, ...)
- High Resolution SAR Images

**Along-Track Interferometry**
- Large Scale Velocity Fields (ocean currents, ice drift, ...)
- Moving Object Detection
- Temporal Coherence Maps

**New Techniques**
- 4 Phase Center MTI (traffic, ...)
- PolInSAR (vegetation height, ...)
- Digital Beamforming (HRWS, ...)
- Bistatic Imaging (classification, ...)
- Large Scale Velocity Fields (ocean currents, ice drift, ...)
- Moving Object Detection
- Temporal Coherence Maps

**TanDEM-X is a highly flexible sensor enabling multiple powerful imaging modes**
- Cross-track baselines (0 km to several km)
- Along-track baselines (0 km to several 100 km)
- Interferometric modes (bistatic, alternating, monostatic)
- SAR modes (ScanSAR, Stripmap, ...)
- Bandwidth / resolution (0 ... 150/300 MHz)
- Incident angles (20° ... 55°)
- Polarizations (single, dual, quad)
- ...
**Commissioning Phase (CP)**

- **Launch and Early Orbit Phase (LEOP)**
  - Duration: 21 June to 19 July 2010
  - Ground station checkout
  - Instrument & processor checkout

- **Pursuit Monostatic Phase**
  - Duration: 7 Cycles (20 July to 07 Oct 2010)
  - Satellite config: ground-track 0m & along-track 20km
  - Safe formation flight & Exclusion Zone Test
  - SAR system calibration campaign
  - SAR system performance
  - Mission planning system operationalisation

- **Bistatic Phase**
  - Duration: 5 Cycles (08 Oct to 29 Nov 2010)
  - Satellite config: Across-track 500m & along-track 0m
  - Bistatic commanding and performance
  - Interferometric processor adaptation
  - Baseline bias characterisation
  - DEM calibration tests & error model verification

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**First TanDEM-X Images (3 days & 14 hours after TDX launch)**

Published on http://www.dlr.de/

Madagascar Stripmap
24.06. 2010 14:55:44 (DT 11)
TanDEM-X / TerraSAR-X – First TSX Image 2007 vs. 2010

Don region (100 km northwest of Volvograd)

"Blind Overlay“ – First TSX Image 2007 vs. TDX Image 2010

R: TSX 2007
G: difference
B: TDX 2010
TanDEM-X / TerraSAR-X – First TSX Image 2007 vs. 2010

Train 2007 (15:03 UTC)
Train 2010 (14:53 UTC)

Single Pass X-band Interferogram
(16 June 2010; 25 km along track & approx. 300 m across track baseline)
Digital Elevation Model
(approx 200m height difference)

TanDEM-X Scientific Experiments: Topic’s

<table>
<thead>
<tr>
<th>TDX Experiments</th>
<th>CP Phase</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal Decorrelation Analysis</td>
<td></td>
<td>~3s time lag suitable for short term temporal decorrelation studies</td>
</tr>
<tr>
<td>Velocity Measurements</td>
<td>Pursuit Monostatic</td>
<td>Only possibility to investigate very long baseline GMTI</td>
</tr>
<tr>
<td>Superresolution</td>
<td>Along-track baseline: 20 km</td>
<td>Investigation of high resolution processing (azimuth)</td>
</tr>
<tr>
<td>Bistatic Experiment</td>
<td></td>
<td>First long baseline bistatic imaging</td>
</tr>
<tr>
<td>Polarimetric SAR Interferometry</td>
<td>Bistatic Phase</td>
<td>Potential of X-band for short volume characterisation</td>
</tr>
<tr>
<td>Double differential SAR Interferometry</td>
<td>Across-track baseline: 500 m</td>
<td>Assessment of the interferometric phase</td>
</tr>
<tr>
<td>Bistatic Processing</td>
<td></td>
<td>Bistatic processing performance</td>
</tr>
</tbody>
</table>
TanDEM-X Proposal Submission

Open for Experimental Products

Please have a look @ http://tandemx-science.dlr.de

Operational Mode Products

<table>
<thead>
<tr>
<th>Commanding</th>
<th>Bistatic</th>
<th>Alternating Bistatic</th>
<th>Pursuit Monostatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>TanDEM-X cooperative mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imaging mode</td>
<td>Stripmap</td>
<td>Stripmap</td>
<td>all basic modes</td>
</tr>
<tr>
<td>Polarisation mode</td>
<td>all basic polarisation modes (incl. DRA mode for quad polarimetry)</td>
<td>Single</td>
<td>all basic polarisation modes (incl. DRA mode for quad polarimetry)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formation Geometry</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Across-track baseline</td>
<td>&lt; 4 km</td>
<td>&lt; 4 km</td>
<td>&lt; 4 km</td>
</tr>
<tr>
<td>Along-track baseline</td>
<td>&lt; 1 km</td>
<td>&lt; 1 km</td>
<td>Any</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processing and Products</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental products generated from the TanDEM-X processor</td>
<td>CoSSC (coregistered slant range single look complex) and interferograms for all acquisitions</td>
<td>Two CoSSC (coregistered slant range single look complex) for all acquisitions</td>
<td>CoSSC (coregistered slant range single look complex) for Stripmap and single polarisation</td>
</tr>
<tr>
<td>Experimental products generated by the TerraSAR-X processor</td>
<td>Standard TerraSAR-X level 1 products* (including geocoding) of the monostatic channel for all acquisitions</td>
<td>Non</td>
<td>Two standard TerraSAR-X level 1b products* (including geocoding) for all acquisitions</td>
</tr>
</tbody>
</table>
Thanks for your attention

TanDEM-X Team