TerraSAR System Evolution – Toward New Applications

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End-To-End Earth Observation Solutions

- Astrium is an Earth observation system provider, integrating all sensor types: high spatial and spectral resolution optical and radar (SAR) systems.
- Astrium and its subsidiary Infoterra are present in all segments of the value chain—forming a true end-to-end provider.
- Astrium together with its industrial and institutional partners offers complete Earth observation solutions, including not only the space- but also the complete ground segment for satellite control, data processing, and thematic applications.

TerraSAR-X 1 m resolution radar system

0.7 m resolution optical system
New Systems for new Applications

National focus on sustainable SAR technology strategy paved the way for:

- **TerraSAR-X** in orbit since 25.6.07, lifetime 5 years fully commercially operational since 14.12.07
- **TanDEM-X** contract award 2006 launch 2009; Tandem operation with TSX for 3 years
- **GMES Sentinel 1** contract award 2007 launch 2011
- **SCOUT** a low cost SAR - instrument approach design and component wise providing highest resolution Technology readiness 2009
- **TerraSAR NG** New Generation (NG) SAR System, based on the SCOUT philosophy with new superior features (HRWS, Digital Beam-forming) enabling new applications and demonstrating leading edge SAR technology
TerraSAR-X

- User driven End to End System Design
- Leading edge SAR Technology
- New class of commercial data quality
  - Up to 1m Resolution
  - Up to 100 km Swath width
  - Polarimetric and Interferometric capabilities
- Operational superiority
  - All weather all day capability
  - Ultra fast system response time (e.g. agility, direct down link)
  - Fully operational order, acquisition and distribution chain
- Commercial Data Exploitation via Infoterra an 100% Astrium subsidiary
- Scientific Data Exploitation through DLR
**TerraSAR-X**
- 1 m Spotlight Image
- Sydney, Australia

*Prel. Image recorded during calibration phase*
TerraSAR-X
- 1 m Spotlight Image
- Sydney, Harbour Bridge, Australia

Prel. Image recorded during calibration phase
TerraSAR-X StripMap Acquisition (3m res) of the Strait of Gibraltar

Prel. Image recorded during calibration phase

Maritime Surveillance
- Ship Detection
- Velocity Measurement
Nov 16 2007: The StripMap image acquired 5 days after an oil tanker broke into two pieces shows massive oil slicks drifting on the surface. 3m resolution / dual polarisation
City of Maowen, Sichuan Province (China)
Infrastructure and Damages by Earthquake

TerraSAR-X
Spotlight Acquisition

Satellite Information:
- Acquisition date: 2008-05-18
- Satellite: TerraSAR-X
- Imaging Mode: Spotlight
- Ground Range Resolution: 1.5 m
- Polarization: HH
- Incidence Angle: 51.1° - 52.3°
- Pass Direction: Ascending
- Acquisition time (start): 11:10:20
- Acquisition time (end): 11:10:30
- Product Type: Geocoded Ellipsoid Conic
- Resolution Mode: Spatially Enhanced

Map Projection:
- Geographic: Universal Transverse Mercator
- Ellipsoid: WGS 84
- Datum: WGS 84
- Zone: 48N

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TanDEM-X: A Globally Consistent, High Resolution Digital Elevation Model (DEM) of the Earth’s Land Surface

- TanDEM-X will be the first bi-static space based SAR-Interferometer set up by the TerraSAR-X and TanDEM-X satellites
- Leading DEM-Quality
  - globally homogeneous, one standard
  - 2 m height accuracy / 12 m posting
- The concept is based on validated technology and actually without competition. Key aspects are
  - Close formation flight (~ 300 m)
  - Instrument synchronisation through inter-satellite link
  - GPS-based precise baseline determination (1-2 mm)
  - Operational DEM processing techniques
GMES Sentinel-1
ESA

- Continuity of C-Band Radar observations (ERS, Envisat ASAR)
  - Marine Services
  - Land Monitoring
  - Emergency Response
- Much improved image and operational performance to satisfy operational user needs (Availability, coverage, revisit, timeliness)
- System Design and RADAR Technology based on TerraSAR-X
- Image Size / Resolution ratio close to the theoretical limit for classical SAR, e.g. 250km/10m
SCOUT:
A new Active Phased Array SAR with further improved cost / performance ratio

- Based on TerraSAR-X Heritage
- Advancing the resolution to VHR (<< 1m)
- Agility and Zoom Capability through Wideband Electronic Beam Steering
- Affordable: Comparable to Reflector Based Systems
- Easily scalable to user needs
- Digital Beam Forming functions can be added to further improve the SAR performance

Next Generation MilSAR based on SCOUT Technology

SCOUT is characterized by:
- Simplified Design
- Higher Integration
- Use of Standardized Components
- Use of new developments with increased efficiency and performance
Earth Observation: Solutions for Decision-Making

TerraSAR New Generation with Digital Beam Forming

Limitations of conventional SAR modes

High Resolution Wide Swath SAR – HRWS patented by EADS Astrium

Stripmap
- moderate resolution & swath width

ScanSAR
- low resolution

Spotlight
- small, discontinuous scenes

HRWS
- continuous coverage
- high resolution
- high mapping performance
Conclusions

- A sustainable and reliable German SAR technology strategy ensured German leading edge SAR capability with high commercial application potential.

- Continuity of this technology strategy by implementing a TerraSAR Next Generation mission will foster new applications, hence new business.

- SAR and Optics sensor data fusion will further complement and improve information content.

- Astrium jointly with industrial and institutional partners is a “one stop shop” end-to-end solutions provider for Earth observation systems—thus an ideal business partner.