TerraSAR-X Improvements in the New Sentinel Era

3rd Copernicus National User Forum (CZ)

Dr. George Vozikis - Airbus DS, Geo-Intelligence
Prague, June 2014
1. AIRBUS DS - GeoIntelligence
   - Who We Are
   - The Airbus DS Satellite Fleet
   - Product Portfolio

2. TerraSAR-X
   - What is new?
     - Wide ScanSAR – Staring Spotlight
     - TerraSAR-X / Paz Constellation
     - WorldDem

3. Sentinel-1
   - Industry Versus Institutional Programs
   - Synergies
   - Conclusion
1 AIRBUS DS - GeoIntelligence
Who We Are
The Airbus DS Satellite Fleet
Product Portfolio
The Power of the Airbus Group

Employees*: ~ 140,000
Revenues*: ~ € 56 bn

Integration & Rebranding
2014

<table>
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<tr>
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<tbody>
<tr>
<td>Airbus</td>
<td>~ 73,500</td>
<td>~ € 39 bn</td>
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<tr>
<td>Airbus Helicopters</td>
<td>~ 22,400</td>
<td>~ € 6.3 bn</td>
</tr>
<tr>
<td>Airbus Defence &amp; Space</td>
<td>~ 40,000</td>
<td>~ € 14 bn</td>
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* Estimate for 2014

4 PROGRAMME LINES
- Geo-Intelligence
- SatComms
- Integrated Systems
- Secure Land Communications
Astrium Services serves customers in more than 100 countries.

Over 100 billion square kilometres of satellite imagery, archived since 1986.

Number of direct reception station partners worldwide: 36

Number of people using our imagery worldwide every year: 1.5 billion

140 resellers worldwide.

Astrium Services, GEO-Information accesses 6 Earth observation satellites, 2 radar and 4 optical.
Never Far Away
A Unique Satellite Fleet

SPOT 5

SPOT 6 & 7

Pléiades

TerraSAR-X

TanDEM-X

DEIMOS-1

FORMOSAT-2

FORMOSAT-2

PAZ

TerraSAR-X Next Generation

0.25m ground resolution

Accurate change detection

Ideal for ship detection over large areas

Daily revisit capacity with the same viewing conditions

Change detection and rapid coverage

60km swath for large-area coverage as a standard

Twin satellites with high resolution [1.5m products]

Secure data continuity for SPOT mission (since 1986)

60km swath for large-area coverage as a standard

Highly reactive system

Geo-Intelligence Business Presentation – Our Assets
Products & Services to Address Your Needs

Optical Imagery
- Pléiades
- SPOT 6/7
- SPOT 5
- DEIMOS-1
- FORMOSAT-2

Radar Imagery
- TerraSAR-X
- TanDEM-X
- PAZ

Reference Layers
- GEO Elevation
- WorldDEM
- SPOTMaps
- PléiadesMaps
- Airport Layer

Software
- I4D
- Pixel & Street Factory
- National Spatial Data Infrastructure (NSDI)
- SAFEcommand

Monitoring Services
- GO Monitor
- Global Seeps
- Oceanway

Easy Access to Data
- Cloud Services
- GeoStore
- Direct Reception Services

A wide range of products and services to offer you the right solution for your needs and make your daily work easier
2 TerraSAR-X
What is New?
Wide ScanSAR – Staring Spotlight
TerraSAR-X / Paz Constellation
The new TerraSAR-X modes

TerraSAR-X  - What is new?

**WS**
- res. 40 m
- 200 – 270 x 200 km²
- Large area maritime monitoring of traffic, oil spills, sea ice...

**ScanSAR**
- res. 18 m
- 100 x 150 km²
- Detailed maritime monitoring & detection

**StripMap**
- res. 3 m
- 30 x 50 km²
- Detection & classification of vessels, infrastructure, etc.

**SpotLight**
- res. 1 m
- 10 x 5 km²
- Recognition of objects (airplanes, hangars, vessels,..)

**ST**
- res. 0.25 m
- 4 x 3.7 km² or 2.5 x 7.5 km²
- Identification of objects

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Monitoring — Detection — Recognition & Classification

TerraSAR-X capabilities today

TerraSAR-X new mode
What do we achieve?

Large area monitoring and mapping…

Figure: Wide ScanSAR acquisition from Panama
What do we achieve?

Pinpointing detail …

Figure: Wide ScanSAR acquisition from Panama
Figure: TerraSAR-X Staring SpotLight acquisition from locks at Panama Canal
Staring SpotLight – Examples

Vessel Berthing @ Peer

Staring SpotLight

HighRes SpotLight
Aviation Museum

Staring SpotLight – Examples

HighRes SpotLight
Aswan High Dam, EGY: Transformer Yard Details

- Transformers
- Stay Poles
Man Made Features in Arid Region

Staring SpotLight – Examples

Small and low buildings

Wall Structures
Sharper Outline of Objects

Control

Staring SpotLight – Examples

Communication mast (lattice construction)

HighRes SpotLight

Staring SpotLight
Staring SpotLight – Examples

Rail Tracks and Rolling Stock

Staring SpotLight

HighRes SpotLight
Tracks within Fields

**Staring SpotLight – Examples**

- **Tractor tracks, **hardly** visible**
  - HS - 2013_07-09_08-22_09-02

- **Tractor tracks, **clearly** visible**
  - ST - 2013_07-20_07-31_08-11
New Radar Constellation between TerraSAR-X / TanDEM-X and new sister radar satellite PAZ

- Launch of PAZ foreseen for 4th Quarter 2014 – yielding a full constellation!
- Much higher revisit frequencies through constellation!
Reaching New Heights

WorldDEMTM
**WorldDEM™**
Standardised Global DEM

The unique and unrivaled combination of **Coverage, Quality, Accuracy, and Availability**, setting a new standard of global elevation models

**WorldDEM™**
Unrivalled Quality

**WorldDEM™**
Accuracy of a New Dimension

**WorldDEM™**
Easy & Instant Access
Reaching New Heights

• **First worldwide, consistent and seamless DEM product**
  – Covering the entire Earth’s land mass (pole-to-pole) with unprecedented accuracy and quality

• **TanDEM-X Mission**
  – Twin Satellites: TerraSAR-X & TanDEM-X flying in a very close and precise formation
  – Mission Goal: homogeneous, high-quality global DEM
  – Data acquisition within 3 years only (one unique source)

• **Public-Private Partnership (DLR/Airbus):**
  – Commercial exploitation: Airbus Defence and Space

• **Specifications:**

<table>
<thead>
<tr>
<th>Product</th>
<th>DSM</th>
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<tr>
<td>Vertical Accuracy</td>
<td></td>
</tr>
<tr>
<td>Abs.</td>
<td>4m (LE90)</td>
</tr>
<tr>
<td>Rel.</td>
<td>&lt;2m (slope ≤20%) (LE90)</td>
</tr>
<tr>
<td></td>
<td>&lt;4m (slope &gt;20%) (LE90)</td>
</tr>
<tr>
<td>Horizontal Accuracy</td>
<td></td>
</tr>
<tr>
<td>Abs.</td>
<td>&lt;10m (CE90)</td>
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• **WorldDEM™ Product Line**
  – **Digital Surface Model (DSM)** representing the surface of earth including heights of buildings and other man-made objects, trees, forests and other vegetation
    – **WorldDEM** – incl. spikes, wells, voids
    – **WorldDEM™** editing of terrain features & water bodies
  – **Coming later: Digital Terrain Model (DTM)** represents the elevation of the bare earth, man-made objects and vegetation are removed
  – **WorldDEM™ commercially available from 2014**
3 Sentinel-1

Industry Versus Institutional Programs

Synergies

Conclusion
**X-band & C-band Radar Benefits**

- **Combine** data-sets to meet revisit & coverage requirements (taking benefit of similar information content in C and X-Band)
- **Cross-cue** sensors using Sentinel-1 large area coverage with TSX/PAZ high resolution to identify small objects, e.g. icebergs, ridges, gaps in maritime environment or perform infrastructure integrity monitoring on land

**Support security-driven requirements**

- **Maritime**: ship detection, search & rescue
- **Terrestrial**: site monitoring (IMINT/GEOINT)

**Support civil-driven requirements**

- **Maritime**: ice monitoring/ship routing
- **Terrestrial**: law enforcement/risk awareness: oil/gas/minerals exploitation, infrastructure integrity
Complementing Sentinel-1 with TerraSAR-X/PAZ

**TerraSAR-X/TanDEM-X/PAZ**

**Sentinel-1**

### C/X Band Operational Benefit

#### Complementarity
- Increased coverage and monitoring frequency

#### Additional Information
- Combining different resolution and C/X Band content

<table>
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<tr>
<th>Ship</th>
<th>Increased coverage and added capacity to survey large areas worldwide</th>
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<tbody>
<tr>
<td>Surface Movement</td>
<td>Provision of a high monitoring frequency</td>
</tr>
<tr>
<td>GEOINT/IMINT</td>
<td>Increased scene density</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Increased coverage</td>
</tr>
<tr>
<td>Forest</td>
<td>Faster acquisitions within given time window</td>
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- Ship detection with Sentinel-1 and ship classification with TerraSAR-X in the same area
- Large scale movement rates (Sentinel-1)
- Small scale detailed movements (TerraSAR-X)
- Disaster Warning, Fracking, Pipeline monitoring
- Coherent Change Detection for smaller objects, detection of smaller targets
- Improves yield estimation
- Detection of crown disturbance
Conclusions

TerraSAR-X Improvements in the New Sentinel Era

Challenging Times
Self-financing of Industry
Market Share of Medium Resolution

Synergies
C-Band vs X-Band
Large Coverage vs Higher Resolution
Static Shooting vs Agile Acquisitions

Awareness
Better Understanding of Applicability of Radar
Increase of User Base
Industry to Make Use of Sentinel Data
Thank You

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