Airbus Optical Constellation

Frascati, November 18th, 2019
Hervé Foch – Head of Imagery, Mapping & LBS projects department
30 years of development and experience alongside our customers and partners
SPOT 6 & SPOT 7

A New Resolution / Coverage Ratio

1.5m Panchromatic & Pan-sharpened product resolution

+ BLUE

6m Multispectral product resolution

12 bits Pixel depth at acquisition

6-10m Geolocation accuracy CE90
Pléiades 1A and 1B

→ A New Resolution / Coverage Ratio

50 cm
Panchromatic & Pan-sharpened product resolution

3 BANDS + NIR

2m
Multispectral product resolution

6.5m
Geolocation accuracy CE90

12 bits
Pixel depth at acquisition
VHR2018
→ 6.3M sqkm
→ 7 sensors

→ Central Airbus processing chain to maximise homogeneity across sensors

→ Strong industrial partnership with 5 partners
GEO in-house reference databases: a long story with the French Mapping Agency (IGN)

Geometric foundation created, maintained and updated by IGN through a co-edition agreement with Airbus since 2002:

- Came from a need of French MoD for a global geometric reference frame (planimetric and altimetric)
- Started with a co-financing Airbus- French MoD in the end of the 90s of a dedicated instrument on board of SPOT5 (HRS: High Resolution Stereoscopic) to acquire a global stereoscopic coverage used as the geometric frame up to now
- Generation of the first derived reference layer for the MoD and Airbus over 80 Mkm², between 2002-2014: Reference3D (ortho-mosaics + DEM)
Planimetric reference layers

GEO ground system (G/S): existing in-house reference databases

The HRS geometric foundation (space triangulation) gives the frame to generate ortho-mosaics layers used as planimetric references by GEO. Different mosaics done at different times with different sensors:

- SPOT5 HRS: Reference3D (2002-2014)
- SPOT6/7: PAS Lama (2016-2018)

Altimetric references:

- Reference3D DSM generated by IGN over 80 Mkm²: DTED2, accuracy <10 m LE90
- SRTM over other areas

Integrated in GEO G/S facilities:

- MOC, DRS
Planimetric reference layers

→ Coverage

GEO ground system (G/S): existing in-house reference databases

<table>
<thead>
<tr>
<th>Reference</th>
<th>PAS (with SRTM DEM)</th>
<th>Reference3D (with R3D DEM)</th>
<th>PAS-LAMA (with SRTM DEM)</th>
<th>Reference3D (with SRTM DEM)</th>
</tr>
</thead>
</table>

**Pixel size**
- **5m (S5-HRS) & 30 m (DEM)**
- **2.5m (S5-HRG) & 30 m (DEM)**
- **2.5m (S6/7) & 30 m (DEM)**

**Accuracy of the database**
- **<10 m CE90**
- **<10 m LE90 (slope <20%)**
- **<5mCE90**
- **<10 m LE90 (slope <20%)**
- **<8mCE90**
- **<15 m LE90 (slope <20%)**

**Accuracy of orthoimages (<30°) produced using these references**
- **<12 m CE90 (slope <20%)**
- **<8 m CE90 (slope <20%)**
- **<12 m CE90 (slope <20%)**
IGN always involved: last co-edition agreement signed between Airbus and IGN the 20th of May, 2019 to prepare the new reference layer for Pléiades Neo (Daniel Bursaux, directeur général IGN & Eric Perez, directeur général ADS GEO SA).

An Airbus radar-based product, WD4O, will replace Reference3D DEM and SRTM:

- A global coverage (all emerged land)
- An unmatched accuracy: 4 m LE90
- Resolution: 0.8 arc second (around 24 m)
The Future: Pléiades Neo CO3D
The Future: Pléiades Neo
Introducing Pléiades Neo

Airbus’ most advanced constellation with very high resolution imagery and optimum reactivity

- Designed for a 10-YEAR NOMINAL LIFETIME
- 30 cm RESOLUTION
- Revisit 2-TIMES A DAY
- 100% COMMERCIALY AVAILABLE
- 4 IDENTICAL SATELLITES
- LAUNCH 2020
30cm resolution

- Highest commercial resolution imagery, combined with accurate geolocation
30cm resolution

Airbus’ most advanced constellation with very high resolution imagery and optimum reactivity
Pléiades Neo
30CM RESOLUTION IMAGERY
Spectral resolution

Pléiades Neo delivers 6 multispectral channels
Deep Blue

An additional spectral channel for bathymetry applications:

→ Deeper penetration in water bodies
→ Clearer understanding of waterways
→ Improved safety of marine navigation
Red Edge

An additional spectral channel for vegetative applications:

→ Crop and vegetation status through photosynthesis characterisation
Geolocation accuracy

Precise location of objects

NATIVE LOCATION ACCURACY

<5m
Receive data on schedule
Intraday revisit anywhere in the world

For frequent site monitoring which fits in with your working day.
Agile System
A Pléiades-like agility
Track

110km

70km

7,500km²

Global coverage capacity

Up to 2 million km² every day!

Up to 7,500 km² in a single pass.
Reactive Tasking & Delivery

- 15 plans / satellite / day
- Customer request up to 15 min before upload
- Time to acquire: 20-50 min
Reactive Tasking & Delivery

→ Rapid coverage at regional scale

→ Enables you to task the satellite up to ten minutes before image collection
SpaceData Highway

- Minimising data latency
- Higher reactivity

10’ up to minutes before collection
<table>
<thead>
<tr>
<th>Geometric performances</th>
<th>Pléiades Neo</th>
<th>Expected target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location accuracy (X,Y)</td>
<td>&lt;5m CE90</td>
<td>&lt;4.0m CE90</td>
</tr>
<tr>
<td>Standard sensor model and RPC model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band registration: PAN-MS</td>
<td>1 pixel PAN</td>
<td>&lt;1 pixel PAN</td>
</tr>
<tr>
<td>Planimetric accuracy (X,Y): standard ortho</td>
<td>5m CE90</td>
<td>5m CE90 (worldwide)</td>
</tr>
<tr>
<td>(Standard reference layers, slopes &lt;20%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planimetric accuracy (X,Y): ultimate ortho</td>
<td>0.3m CE90</td>
<td>&lt; 0.3m CE90</td>
</tr>
<tr>
<td>(Perfect references, slopes &lt;20%)</td>
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<td></td>
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<tr>
<td>Vertical accuracy (Z): ultimate DEM</td>
<td>0.6m LE90</td>
<td>&lt;0.6m LE90</td>
</tr>
<tr>
<td>(B/H 0.5, perfect references, slopes 20%)</td>
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CO3D
CO3D main challenges

Worldwide DEM
Goal 2025

Low-cost full-automatic cloud-processing

Altimetric accuracy
Goal 1m (relative)

Low-cost EO satellite constellation
50 cm imagery
Program goals

→ RESEARCH
  Make a 12-month demonstration

→ DATA
  Provide a pre-operational system for 3D services, with a competitive institutional guaranteed access for any future orders of DEM

- Metropolitan FRANCE
  500 000 km²
  90% coverage

- Arc Of Crisis
  27 Mkm²
  80% coverage
Mission performance: altimetric accuracy

Full automatic DSM generation
- 1 m GSD
- 1 m LE90 relative (2 m LE90 absolute) altimetric accuracy

Full automatic DTM generation (under discussion)
- 5m GSD
- 5 m CE90 X,Y,Z absolute accuracy

- **DTM**: Digital Terrain Model
- **DSM**: Digital Surface Model
CO3D Image Quality

- **R,G,B**
  - 0.50 m GSD
  - MTFstatic ~7 % @ Fe/2
  - SNRR,G,B ~ 30 @ 15 W/m²/sr/µm

- **NIR**
  - 2 m GSD
  - MTFstatic ~ 20% @ Fe/2
  - SNRNIR ~ 20 @ 15 W/m²/sr/µm

- 14 km swath
- System Geoloc
  - < 10 mCE90

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CO3D image simulation 50 cm R,G,B – Tarragone (Spain)

CO3D image simulation 2 m NIR Amiens (France)
Quadruplet in « Diamond Geometry » reduces noise and occlusions thanks to azimuth viewing angle variety. Particularly interesting over urban areas...
Conclusion
Enable to:

- Disseminate
  - Free Institutional imagery
  - Commercial imagery

- Access
  - processing & analytics capabilities

- Develop new services

Share them within a global community

Via one Digital Ecosystem
- DATA
  - Archive and Tasking from Multi-resolution and sensors
  - Airbus Constellation; Sentinel data
  - Layers: Basemap, WorldDEM streaming
  - Advanced products: orthos, mosaics, 3D models

- ANALYTICS

- SOFTWARE

- THEMATICS SERVICES

- LINK TO AIRBUS DEVELOPMENT PLATFORM

- DATA SOURCES

- DIGITAL ECOSYSTEM

- USERS COMMUNITY

Institutions
Private Sector
Scientists
Developers
Civil Society
Thank you