Space Situational Awareness
Optical Solutions

International Symposium on Ensuring Stable Use of Outer Space
~ Enhancing Space Security and Resiliency ~ Tokyo

March 3rd 2016 – Yannick Devouassoux
Agenda

- SSA context & Solutions developed by Airbus Defence & Space
- Focus on GEOTracker
- Focus on laser demonstration
- Optical solutions in development
- Conclusion - Q&A
Security in Space: a definition

Space Surveillance & Tracking (SST)
- Survey
- Orbit determination
- Identification
- Recognised Space Picture

Space Weather

Space Traffic Management

NEO

Space Situational Awareness (SSA)

Access to space
- Autonomy to launch
- Launch security
- Launch detection

Space debris management
- Risk assessment
- LDR (Laser Debris Removal)
- ADR (Active Debris Removal)

Resilience:
- Satellites
- Ground infrastructures
- Ground to space comms

Preemptive actions
- From ground
- In space
- From space

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Airbus DS solutions allow autonomous use of space through independent assessment of events in the economically and strategically important orbits near Earth.

- **GEO Tracker**: A network of optical sensors for survey and tracking of GEO/MEO space objects.
- **Active Laser ranging**: High accuracy for LEO tracking & Characterization.
- **Additional optical solutions**: Lucky imaging and LEO survey.
Functions

- GEO and MEO space objects tracking
- GEO survey for detection and orbit determination

Performances and specifications

- Coverage: GEO arc between -44W to +56E longitude (from Nice)
- Operating under normal weather conditions - 10 to + 40°C Celsius and 40 km/h wind speed
- Detects objects >1m in GEO
- Tracking accuracy < 4 arcsec
- Angular measurement accuracy < 1 mdeg (0.03,6 arcsec)

Key features

- Full remote operations
- Very high pointing accuracy and repeatability

An operational network dedicated to space surveillance missions and services
GEO Tracker architecture

The secured architecture ensures data confidentiality

- Daily measurements (RA, DEC, t, error)
- Observations report
- Sensor state report

Airbus Defence & Space site

- Observations sequence (format TLE + observation slot)
- Direct orders (Azimuth/Elevation format)

Secured area

Distant observation site

Command/Control

Optical sensor

Secured connexion

Mass storage
(Observation data)

Operator terminal
(Tasking & monitoring)
GEO Tracker
Focus on Airbus DS’s laser station

Functions
• High accuracy space objects tracking/ Trajectography for
  • CDM verification / refinement
  • Orbit control, complementary to radar systems

Performances specifications
• Objects: size > 0.10m, elevation min > 25°, range < 2000km
• Ranging accuracy: +/- 3 m
• Azimuth and Elevation vs time: +/- 50 m or < 1 mdeg

Operational requirements
• Automatic station with remote capabilities
• Meet Laser Safety Standards
• Minimize operational and maintenance cost
• Night operations
Validation of the station’s design & processing chain

- Laser upgrade from a few mJ to 2J per pulse
- Target fine tracking starting from low accuracy data
  - from ± 10 km to ± 25 m tracking accuracy
- Tracking of debris
  - Speed: 7500 m/s
  - Altitudes: 800 km – 1500 km
  - Surface: 2 x 2.5m
- Safety coordination with DGAC Nice and French Air Force (NOTAM)

ADS-B Automatic Dependent Surveillance-Broadcast

Device
- ADS-B portable receiver (model SBS-1eR) with an antenna and Basestation software
- Virtual radar for air traffic visualisation on our own screen
- In-house software to identify all aircraft which will penetrate in a predefined safety cone around the laser and alert operator to stop the laser

Laser on Laser off

Laser safety regulations for Air traffic and Space traffic process and technologies
Observation campaigns results: First echo on SL14 18794 the 20/03/2012
Observation campaigns results: 10 non cooperative objects tracked during the last campaign

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Accuracy improvement with laser measurements

A tested laser-based solution for accurate LEO orbit determination
Operational needs
- Detect and catalog small space objects (Micro & nano-satellites)
- Maintain recognised space picture
- Detect, recognize and identify new objects
- Information on all events

Solution in development and test at Airbus Defence and Space
- Preliminary test in 2015
- Network architecture study
- Survey optical station development

Test in the coming months

Promising solution to complement radar sensors for LEO survey of small space objects
A technique currently used in astronomy to deal with atmospheric turbulence effects

- Acquisition of images with a classic telescope and a short integration time camera

- Post treatment of pictures
  - Automatic Selection of the best images
  - Combination of the best images to improve resolution

Preliminary results from November 2015

Feasibility demonstrated, needs industrialisation for operational use
To summarize the Airbus DS Solutions offer

Access to a demonstrated SSA capability and knowledge

Be part of the Airbus DS optical stations network

Acquire assets to provide SSA services for local needs