Report on CEOS WGCV SAR Subgroup Activities

CEOS WGCV 37th Plenary
ESRIN, Frascati/Italy
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CEOS SAR CAL/VAL Workshop 2013

Joint Workshops: ASAR & CEOS WGCV – SAR Subgroup

The 20th CEOS SAR Calibration and Validation Workshop will be held jointly with the 9th Advanced SAR (ASAR) Workshop organized by the Canadian Space Agency (CSA) from **October 15–18, 2013** at CSA's John H. Chapman Space Centre in St. Hubert near **Montreal, Canada**.

Dedicated CEOS Session

Friday, **October 18**, will be dedicated to sessions on:

- Quality Assurance for Earth Observation (QA4EO)
- Product structures and formats
- Cal/Val test sites

CEOS SAR CAL/VAL Workshop 2013

- In total more than 180 participants
- About 120 papers have been presented during 3-day (15-17 Oct) workshop in three parallel sessions
- Contributions from worldwide SAR programs, main focus on RADARSAT-2 and Radarsat Constellation Mission
- Dedicated CEOS session on 18-Oct:
  - Summary of cal/val and SAR processing sessions
  - Test sites & targets
  - QA4EO
  - Product structures

Transponder Architecture

- A single antenna for both reception and transmission
- A microwave transceiver to frequency shift signals
- Digital Signal Processor for the programmable delay on the signal, to fine tune the gain to achieve a 76 dBm2 radar cross section (RCS), and to apply a transponder compensation filter.
- Support subsystems
  - a control and data storage computer;
  - a GPS Clock for UTC synchronization;
  - a Pan-Tilt unit for orienting the antenna boresight towards the expected satellite overpass location;
  - support for external communications, enabling full remote control and a data download capacity;
  - a power supply;
  - an environment control system.

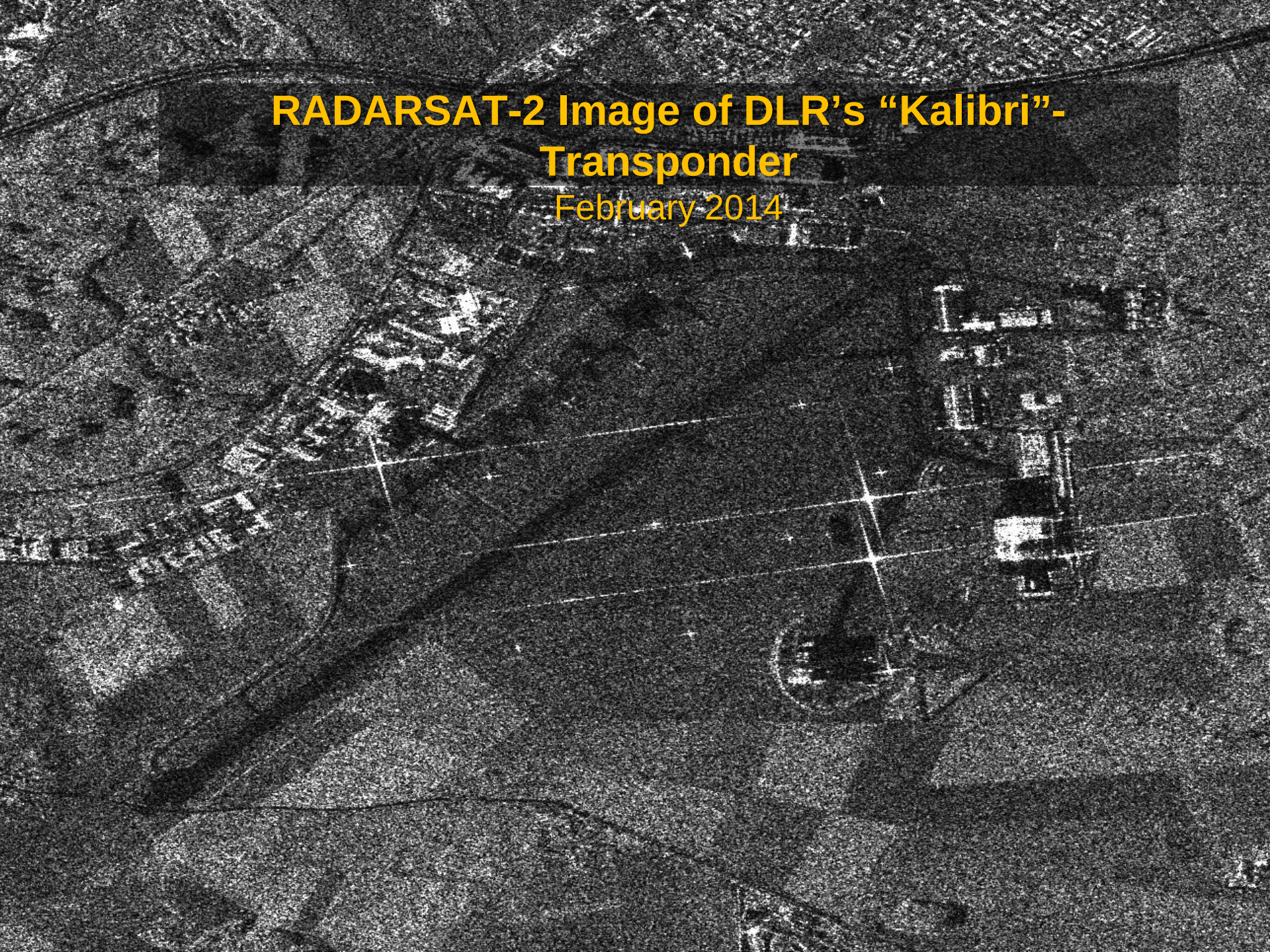
DLR‘s New Calibration Targets „Kalibri“

3 Corner Reflectors

- Remote control
- Leg Length 2.8m
- RCS: 49.2 dBm²

3 C-Band Transponders

- Remote control
- Stability: 0.1 dB
- Accuracy: 0.2 dB
- RCS: 60 dBm²



RADARSAT-2 Image of DLR's "Kalibri"-Transponder

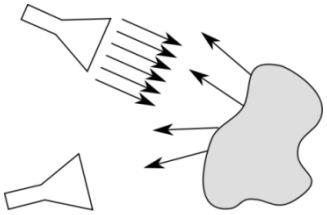
February 2014

The RCS Problem in SAR

A SAR system *does not* measure a point target's RCS. Instead, it measures a *weighted* (over chirp bandwidth and azimuth angles) *complex backscatter* (phase is important).
Distinction between two domains is crucial and a prerequisite for uncertainty analysis (and therefore traceability in radiometric measurements).

RCS: Body property

RCS = Ratio of powers per freq. and angle



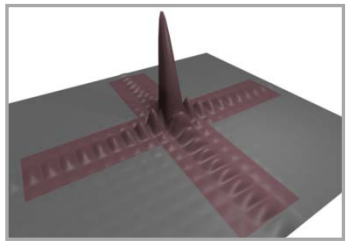
$$\sigma = \lim_{R\to\infty} 4\pi R^2 \left|\frac{E_r^2}{E_i^2}\right|$$

Depends on: Frequency, bistatic angle, polarization, shape, material, …

SAR measurement quantity: Pixel intensity

Results from correlation of complex amplitudes („averaging over frequency and angle")

$$I(x,y) = [\underline{K}\,\underline{S}(x,y) \otimes \underline{h}(x,y)]^2$$



Depends on: SAR bandwidth, azimuth angle range, apodization functions, …

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Proposed New Measurement Quantity
ERCS: The RCS replacement

> The **equivalent radar cross section (ERCS)** shall be equal to the radar cross section of a perfectly conducting sphere which would result in an equivalent pixel intensity if the sphere were to replace the measured target.

(Exploit sphere's freq. and angle independent RCS.)

What stays the same?

- Measurement procedure: No additional correction factors necessary
- Measurement unit: [m²]
- Understanding: Still thinking of ratio "reflected/incident power"

What changes?

- Annotation → More clarity (know what you measure)
- Calibration! Reference for absolute radiometric calibration must be given with known *equivalent RCS*, not *RCS*
- Definition works for high-resolution SAR systems

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QA4EO SAR Implementation

- See presentation in QA4EO session

SAR Subgroup Recommendation 2013 - 1

Future cooperative missions should harmonize product specifications and definitions. For international cooperative missions the data policies should match this recommendation.

Issue: Operation of individual missions in virtual constellations (e.g. TerraSAR-X/TanDEM-X and the Spanish PAZ, Sentinel-1 and Radarsat Constellation Mission) requires harmonized products and similar data policies.

Decision Making Level: CEOS Plenary

Nature of Recommendation: for endorsement

SAR Subgroup Recommendation 2013 - 2

Mission Operators should ensure product quality by providing necessary instrument information also for licensed third-party processing chains. As an alternative of providing Level 0, range-compressed (corrected for instrument specific characteristics) so-called Level 0b should be provided.

Issue: To ensure comparable product quality processors (including 3rd party processor) for one mission should be unified and/or certified.

Decision Making Level: CEOS Plenary

Nature of Recommendation: for endorsement

SAR Subgroup Recommendation 2013 - 3

Protect EO frequency bands!

Issue:

Radio Interference is becoming a more and more disturbing problem:

- in case of P- & L-Band due to early warning and air traffic control radars
- in C-Band Wireless Communication Networks are claiming access to the EO-frequency band

Decision Making Level: CEOS Plenary

Nature of Recommendation: urgent call!

CEOS SAR CAL/VAL Workshop 2014

to be held jointly with

June 02-06, 2014, Berlin, Germany

similar setup as this years workshop: 3-days EUSAR 2014 conference followed by extra day dedicated to CEOS specific topics