Transponders and Corners

DLR’s Next Generation SAR Calibration Targets

Björn Döring, Marco Schwerdt

CEOS 2013, Montreal
South Germany
DLR Calibration Field

Permanent installation:
• 4 trihedrals (1.5 m) in
  N Germany
South Germany
DLR Calibration Field

Permanent installation:
4 trihedrals (1.5 m) in N Germany

Stand-by calibration field (S Germany):
• 24 trihedrals (1.5 m)
• 6 trihedrals (3.0 m)

New installation 2013/14
• 3 trihedrals (2.8 m)
• 3 C-band transponders (60 dBm²)
Remotely Controlled 2.8 m Trihedrals

- Corners are remotely controlled
- Realignment per overpass/mission
- Design allows parking position (better protection)
- Low mechanical tolerances (< 1 mm), verified by laser measurements

Considerable foundation (geometric calibration!)
- Foreseen lifetime: > 15 years
- Installation: 2013

Proof-of-concept measurements

FAT in July 2013
2.8 m Corners Compatible with all Known Missions

Corners are good candidates for cross-calibrations as well as for accurate, long-term geometric and radiometric monitoring.
Kalibri Transponders

<table>
<thead>
<tr>
<th></th>
<th>C-band</th>
<th>X-band</th>
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</thead>
<tbody>
<tr>
<td>Devices</td>
<td>1 prototype 3 production</td>
<td>1 prototype</td>
</tr>
<tr>
<td>Center frequency</td>
<td>5.405 GHz</td>
<td>9.650 GHz</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>100 MHz</td>
<td>600 MHz</td>
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- RCS: 60 dB
- Modular design (C and X band)
- Adjustable TX/RX polarization (antennas motorized)
- Pulse recording (coherent & pulse powers) with GPS time tags (timing uncert. 150 ns)
- High gain stability (0.01 dB)
- Gain monitoring implemented
- Mounted on positioner (parking position supported)
- Autonomous operation
- Remote configuration
- Extensive external calibration efforts (RCS std. uncert. 0.2 dB)
Pulse Power & Coherent Pulse Pulse Recordings

Relative Receive Power (filtered)

Normalized receive power [dB]

Relative overpass time [s]

Transponder: Kalibri2
Conf. center time: 2013-04-14T17:07:47.572593 UTC (= 0 s)
Rel. time at maximum: -1.964291 s
Max. digital RMS amplitude: 246.2
Pulse count (full): 7939 (823)
High RCS Stability
(std. uncert. 0.01 dB)

- Minimal number of parts outside internal calibration loop
- FPGA allows fine gain (i.e. RCS) adjustments (< 0.01 dB)
High RCS Stability
(std. uncert. 0.01 dB)
Further Transponder Features

- Corrugated horns designed and fabricated in-house
- High x-pol isolation (> 45 dB)
- High decoupling allows simultaneous TX/RX
- Settable delay (modify range position)
- Temperature controlled housing (custom heat exchanger)
Transponder RCS Calibration

- Absolute calibration accuracy unprovable
- Plausibility checks necessary
- Several independent transponder calibration campaigns performed/planned:
  - DLR outdoor measurement range
  - DLR compact test range
  - RADARSAT-2 campaign
  - (novel method being tested)
First RADARSAT-2 Image of Kalibri Prototype
April 2013

- 15 reference corners deployed around Oberpfaffenhofen
- 8 overpasses
- Many thanks to MDA for providing the data!
Conclusions

3 New 2.8 m Reference Corner Reflectors
- Accurate
- Remote controlled
- Built to last

3 New C-Band Transponders
- Polarimetric
- Stable
- Accurate