Pre-launch Verification of the Sentinel-1 Commissioning Phase Facility

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1. Commissioning Phase Calibration and Performance Analysis Facility (CPAF) Development and Overview

2. Simulated SAR (SIMSAR) generation through the use of a reversed SAR processing chain
Main objective:
for purpose of calibration, validation and performance analyses tasks
during the Sentinel-1 (A+B) commissioning phase in order to verify the
performance requirements in-orbit

Main functionality:
• Mission Planning & SAR data ingestion from PDGS
• S-1 HKTM data ingestion from FOS
• Internal Calibration Analysis
• Operation of the S-1 Transponders
• External Calibration Analyses (pointing, geometric & radiometric)
• Pattern Calculation using the Antenna Model
• Performance Analysis
• Telemetry and SAR Header Data Analysis
• Product Verification
• Re-calibration after Satellite Constellation Update
CPAF Overview

S1-CPAF

- Core
  - Algorithm Toolboxes
  - Monitor & Control
    - Product Viewer
    - External Interface Emulators
    - CPAF HMI
- Archive & Inventory
- Characterisation and Radar DBs
- Sentinel1 PP
- Antenna Model
- Earth Explorer
- CFIs
- User
- PDGS FOS
- S1-Transponders
• Data driven process flow
CPAF Overview / Level-0 (2/2)
3 main lines in L1 tools
- Elevation antenna pattern estimation
- Point target analysis
- Distributed target analysis
CPAF Status

- CPAF infrastructure delivered to ESTEC
- Interferometric verification tools currently integrated within CPAF
- SW functional tests completed: system operational – apart from a number of updates in order to properly reflect pre-launch system baseline
- Data driven, thus need for S-1 datasets to explore and test the system’s full functionality
- Simulated S1 data required in proper formats – both Level-0 and Level-1 – to work with CPAF
Motivation:

- Large scale raw data processing (incl FDBAQ)
- Point target based system simulators have slow performance for extended scenes
- Allows representative S1 product generation
→ The GBM database only covers the land masses
→ Over ocean the CMOD model with wind parameters from the WindSat mission has been used
Input parameterisation

1. Antenna parameters (length or beam patterns, sweep rate)
2. Radar carrier frequency
3. Orbit
4. UTC time for first data line
5. PRF and rank
6. Range sampling frequency
7. Sampling window start time
8. Sampling window length
9. Burst length (# lines)
10. Pulse parameters (nominal) or sampled pulse (replica)
11. Doppler (none, geometric using steering law, other)
An investigation using Radarsat-2 data (SCWA) to investigate resolution impact on FDBAQ compression with 50 meter and 500 meter input product.

- **50m**: 3 burst cycles (~8s)  
  - 203 MB

- **500m**: 202 MB
Inverse processing example

GBM product: 150 seconds of EW

Input reflectivity
(single burst/subswath)

Simulated raw data

Simulated raw data
FDBAQ compressed

Calibrated SLC
Inverse processing performance
IW product of 6 burst cycles

FDBAQ performance: The compressed file size for this product is 2 x 2.85 bits per complex sample, including “overhead”

Simulation speed: ~45 min on a standard desktop computer (2.7GHz Intel i5 processor, 8 Gb RAM) for 16 seconds dualpol IW output, using a single CPU core. FDBAQ compression and space packet formatting ~50%
Output format: Sentinel-1 space packet data format

Scope of simulation: Two different data sets will be simulated. All S-1 modes will be simulated. Some scenes will also contain simulated point targets in order to emulate transponder signals.

1. GSVDS: For use by ESA in ground segment validation tests. This dataset consists of 349 products of length from 5-1500 seconds. The total amount of raw data is about 1.4 TB.

2. CPRDS: For use by ESA in commissioning phase rehearsal tests. This dataset consists of around 1400 products, and the expected amount of simulated raw data is around 7 TB.

→ CPRDS allows a behavioral analysis of the full CPAF environment including realistic assessment of timeliness before launch of Sentinel 1-A
## CPRDS Dataset Selection

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<tr>
<th>Region</th>
<th>Mode</th>
<th>Tx Pol</th>
<th>Rx Pol</th>
<th>Time since ANX (sec)</th>
<th>Start date and time</th>
<th>time (chop based)</th>
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Questions

Thanks for your attention