DORIS : a few new system features in 2015

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IDS AWG, May 28th, 2015
SCOPE

– Fourth Generation Beacon (« B4G ») :
  status
– Near-Real-Time Pole coordinates
– Near-Real-Time Receiver Frequency Bias
– Near-Real-Time Beacon Frequency Bias
Fourth generation Beacon

– Electronic design with 2015 components
– RF wires longer (up to 50 m) allowing better masks clearances
– Already integrated in existing system

– Schedule :
  • Tender on line (on May 13th)
  • Final choice by the end of 2015
  • Prototype and pre-production units by mid-2017
  • First production units by the end of 2017
DORIS Auxiliary Data

• New TM format containing on board estimates
  – Pole coordinates and drifts
  – Beacons and satellites USO frequencies and drifts

• Will be available for Jason3 and Sentinel3
  – Available in Near-Real-Time (typically 3h)

• Goals
  – Deliver real-time pole estimates with a good accuracy
  – Deliver a real-time monitoring of the beacons network frequencies

• Ground activation for Cryosat2, HY2, Jason2, Saral
Pole coordinates and drifts

- **DIODE estimation strategy**
  - Satellite positions-velocities
  - On-board and on-ground frequency biases
  - Hill along-track, Cross-track Drag
  - Upole Vpole
  ...

- **Variation model for period < 1 day**
  - Described in IERS conventions

- **Outputs**
  - Smoothed mean pole coordinates
  - Mean pole drift

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Pole: inter-satellite comparison

• In theory, same pole for all the satellites

• Ground activation with the last DIODE version
  – On a calm period without maneuver or event
Pole: inter-satellite comparison

- Mean pole comparison: DIODE – IERS bulletin B

<table>
<thead>
<tr>
<th></th>
<th>Cryosat2</th>
<th>HY2</th>
<th>Jason2</th>
<th>Saral</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLE_U</td>
<td>1.499E-03</td>
<td>1.427E-03</td>
<td>1.223E-03</td>
<td>1.242E-03</td>
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<tr>
<td>POLE_V</td>
<td>1.597E-03</td>
<td>1.491E-03</td>
<td>1.099E-03</td>
<td>1.384E-03</td>
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</tbody>
</table>

RMS (arcsec) on the converged period
Pole: multi-satellites melting

- The four poles estimates are mixed: composite value

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MEAN</th>
<th>ST DEV</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLE_U</td>
<td>-1.874E-03</td>
<td>1.472E-03</td>
<td>-0.151E-03</td>
<td>6.023E-04</td>
<td>0.621E-03</td>
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<td>POLE_V</td>
<td>-1.635E-03</td>
<td>1.651E-03</td>
<td>-0.121E-03</td>
<td>4.621E-04</td>
<td>0.477E-03</td>
</tr>
</tbody>
</table>
Frequencies and drifts

• DIODE estimation strategy

Satellite positions-velocities
On-board and on-ground frequency biases
Hill along-track, Cross-track
Drag
Upole Vpole
...

Doppler Filter
Derivation Filter

On-board and on-ground frequency biases
Frequency drifts

• Outputs
  – Smoothed on-board and on-ground frequency estimations
  – On-board and on-ground frequency drifts
Smoothed on-board frequency

• Comparison to T2L2 on Jason2

Compliance: $1.2 \times 10^{-12}$

Results presented in next JASR issue

• On-board Sentinel 3: GNSS receiver for direct comparison
Frequencies: inter-satellite comparison

- On-board frequency depend on the satellite
- But same beacon frequencies for all satellites

Good consistency at first sight (One estimate per pass)
Frequencies: inter-satellite comparison

- DIODE frequency drift used for extrapolation between two passes

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<th>Saral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-0.149E-12</td>
<td>-1.477E-12</td>
<td>0.813E-12</td>
<td>-0.754E-12</td>
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<tr>
<td>RMS</td>
<td>1.635E-12</td>
<td>2.264E-12</td>
<td>1.898E-12</td>
<td>1.610E-12</td>
</tr>
</tbody>
</table>

Statistics ($\frac{\delta f}{f}$) on the converged period

- Future REGINA GNSS receivers for direct comparison

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Conclusions, perspectives

• Poles coordinates: results are promising
  – RMS of mixed solution: ~0.5 mas
  – Need parameters optimization (kalman filtering)
  – Information can be reduced to one point every 2h
  – May be useful for IDS analysts?

• Smoothed frequencies
  – RMS on-board as on-ground: < 2.0 \times 10^{-12}
  – Further investigation for short/mid-term frequency estimation
  – Useful for Integrity Survey
  – May be useful for IDS analysts?

Thank you!