ACTIVITIES IN THE FRAME OF THE EPN ANALYSIS COMBINATION CENTRE

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Since June 2013 duties of the EPN Analysis Combination Centre (ACC) are performed by the consortium of two Polish universities:

- Military University of Technology (Warsaw, Poland)
- Warsaw University of Technology (Warsaw, Poland)

The whole team consists of:

- Andrzej Araszkiewicz (MUT),
- Mariusz Figurski (MUT),
- Grzegorz Nykiel (MUT),
- Tomasz Liwosz (WUT),
- Karolina Szafranek (MUT).
In November 2013, "Guidelines for the EPN Analysis Centres" were updated:

- Final daily coordinate solutions became mandatory.
- Use of orbits and clocks consistent with the analysis options and software used by each LAC (or combined IGS products).
- Exclusion of defective satellites.
- Encouragement for LACs to perform specific tasks.
- Update of processing options (e.g. mapping functions).
- Changes to keep Guidelines up-to-date (e.g. IGS instead of ITRF).
- Distribution of stations among LACs (3-5 except twin stations).
CURRENT STATUS OF COMBINED SOLUTIONS:

- Final weekly solution: submission since 1768;
- Final daily solution: submission since 1788;
- Rapid daily solution: submission since 1770;
- Hourly (ultra rapid) solution: submission since 17733;
- TIGA subnetwork solution: no submission.
1. Solutions in SINEX are transformed into normal equations (SNX2NEQ).

2. All **normal equations are combined using ADDNEQ2** (1\textsuperscript{st} iteration of combination). The alignment to the IGb08 is made by adding minimal constraints.

3. **Stations coordinates** specific for different LACs are compared with their **mean values**. In case the differences are higher than 8 mm horizontally or 16 mms vertically such station is eliminated from the specific solution - the whole set of normal equations has to be rebuilt.

4. **The adjustment is repeated** (2\textsuperscript{nd} iteration) and the same criteria are checked again. If necessary, the 3\textsuperscript{rd} iteration is also being made.

5. Helmert transformation parameters between weekly combined and reference solution are determined and **coordinates values of reference stations are also compared**. If the differences are higher than 8 millimetres horizontally or 15 millimetres vertically such stations is not being used as a reference and the adjustment is repeated.
Solutions analysis – final weekly

EUREF REPORT FOR GPS WEEK: 1777

Agreement between LACs solutions
(horizontal component - mm)

0.5 1.0 2.0 3.0 5.0 excluded from some of the LAC's sol.

http://epnacc.wat.edu.pl/
Solutions analysis – final weekly

EUREF REPORT FOR GPS WEEK: 1777

Agreement between LACs solutions
(vertical component - mm)

0.5 1.0 2.0 3.0 5.0

excluded from some of the LAC's sol.

http://epn.acc.wat.edu.pl/
Time series of translation (X component) of Helmert transformation
Time series of rotation (X component) of Helmert transformation
Time series of scale parameter of Helmert transformation
• 1 day latency;
• 9 LACs contribute;
• Currently ~95% stations monitored (but many processed by 1 LAC only);
• Metadata in LACs SINEX files checked against log files
  - problematic stations excluded,
  - notification emails already sent to LACs;
• Software used for combination: Bernese 5.2;
• Products and reports from combinations available at the BKG EPN data center.
Number of LACs processing each station in rapid daily combined solution (example for day 17932)
Stations availability in rapid combined solution for last 4 weeks (1790 – 1793)
• 1 hour latency;
• Only 3 LACs contribute;
• Near real time monitoring of EPN station positions;
• Metadata in LACs SINEX files checked against log files (problematic stations excluded);
• Software used for combination: Bernese 5.2;
• Products and reports from combinations available at the BKG EPN data center.
### Changes in LACs analysis

<table>
<thead>
<tr>
<th>Activity</th>
<th>GLONASS</th>
<th>BSW 5.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEK</td>
<td>1501</td>
<td>1786</td>
</tr>
<tr>
<td>BKG</td>
<td>1610</td>
<td>1730</td>
</tr>
<tr>
<td>COE</td>
<td>YES</td>
<td>1730</td>
</tr>
<tr>
<td>IGE</td>
<td>1756</td>
<td>1756</td>
</tr>
<tr>
<td>IGN</td>
<td>1774</td>
<td>1774</td>
</tr>
<tr>
<td>LPT</td>
<td>1400</td>
<td>1731</td>
</tr>
<tr>
<td>MUT</td>
<td>1755</td>
<td>1755</td>
</tr>
<tr>
<td>NKG</td>
<td>1765</td>
<td>1765</td>
</tr>
<tr>
<td>OLG</td>
<td>in progress</td>
<td>in progress</td>
</tr>
<tr>
<td>RGA</td>
<td>1752</td>
<td>1752</td>
</tr>
<tr>
<td>ROB</td>
<td>1400</td>
<td>1765</td>
</tr>
<tr>
<td>SGO</td>
<td>1760</td>
<td>1760</td>
</tr>
<tr>
<td>SUT</td>
<td>in progress</td>
<td>in progress</td>
</tr>
<tr>
<td>UPA</td>
<td>1764</td>
<td>1764</td>
</tr>
<tr>
<td>WUT</td>
<td>1609</td>
<td>1765</td>
</tr>
</tbody>
</table>
Use of Bernese 5.2 and GLONASS analysis (scale parameter)
Changes in combinations

- **Change of reference stations for combined solution:**

At the beginning the same set of reference stations was applied as the one used by BKG - 97 (82 in fact) EPN stations with coordinates expressed in IGb08. Since 1788 GPS week only stations belonging to the IGb08 are used – only 41 stations (differences in coordinates below 2 mm).

- **Exclusion of stations processed by less than 3 LACs** (1774 GPS week):
Changes in combinations

• Shorter version of combination reports sent by mailing lists.

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TABLE 1: NOTIFICATION OF DETECTED OUTLIERS - EXCLUDED STATIONS

<table>
<thead>
<tr>
<th>Station</th>
<th>LAC</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELL 13431M001</td>
<td>IGN</td>
<td>-16.91 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>CANT 13438M001</td>
<td>IGN</td>
<td>-17.57 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>CEBR 13408M001</td>
<td>ASI</td>
<td>27.65 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>LAMP 12706M002</td>
<td>ASI</td>
<td>18.38 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>MELI 19379M001</td>
<td>ASI</td>
<td>-16.01 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>MOPI 11507M001</td>
<td>WUT</td>
<td>22.86 Too large residual in comparison between LACs.</td>
</tr>
<tr>
<td>VILL 13406M001</td>
<td>ASI</td>
<td>19.17 Too large residual in comparison between LACs.</td>
</tr>
</tbody>
</table>

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TABLE 2: FINAL COMPARISON OF SOLUTIONS

a) Helmert Transformation Parameters With Respect to Combined Solution

<table>
<thead>
<tr>
<th>LAC</th>
<th>Rms (m)</th>
<th>Translation (m)</th>
<th>Rotation (&quot;)</th>
<th>Scale (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X   Y   Z</td>
<td>X   Y   Z</td>
<td></td>
</tr>
<tr>
<td>ASI</td>
<td>0.00268</td>
<td>-0.0138 0.0283 0.0125</td>
<td>-0.0006 -0.0006 0.0007</td>
<td>-0.00022</td>
</tr>
<tr>
<td>BEK</td>
<td>0.00094</td>
<td>0.0081 0.0065 -0.0018</td>
<td>-0.0002 0.0002 0.0001</td>
<td>-0.00108</td>
</tr>
</tbody>
</table>

• Full versions of reports are available on ftp servers: EPN CB.
METAchecker - main features

- Checks availability of LAC snx files on BKG ftp server;
- Checks three section of SNX files wrt the euref.snx:
  - SITE/RECEIVER (receiver model, s/n, date installed, firmware),
  - SITE/ANTENNA (antenna model, s/n, date installed),
  - SITE/GPS_PHASE_CENTER;
- Automatically compares most recent versions of snx files (both for LAC and EUREF files);
- Possibility of checking all LAC at once;
- Possibility of checking LAC for any numbers of weeks;
- Error log sending by an e-mail;
- Supports both Windows and Linux OS;
METAchecker – example of error log file

lac17876.snx

$SITE/RECEIVER - RECEIVER MODELS
EUSK LEICA GRX1200GGPRO LEICA GR25
HOE2 LEICA GRX1200+GNSS JAVAD TRE_G3TH DELTA

$SITE/ANTENNA - RECEIVER ANTENNA MODEL
EUSK LEIAT504GG LEIS LEIAR25.R4 LEIT

$SITE/ANTENNA - RECEIVER ANTENNA S/N
EUSK 00460 25299
BADH 6-022 56022

Data in LAC.snx file
Data in euref.snx file
According to the new challenges which EPN has to face, current Local Analysis Centres are invited to contact EPN CB and ACC to discuss a possible re-orientation of their contribution to the EPN. The most urgent necessities are related, among others, to the real-time analysis, control analysis using different types of software and analysis made for the purpose of testing new strategies and models.

- **Local Analysis Centres** (LAC, routine contribution) estimate daily and weekly station positions and zenith tropospheric path delays for selected EPN stations.

- **Dedicated Analysis Centres** (DAC) analyse GNSS data as a contribution to EPN products which are still under development or products generated by EUREF Working Groups (e.g. reprocessing, densification, monitoring,...)
GOP (Geodetic Observatory Pecny) LAC decided to focus on the reprocessing activities and resign from routine weekly submissions (since 1773).

GOP LAC processed data from 71 EPN stations; Some of them were distributed among other LACs to make sure that all stations are processed by 4 or 5 LACs (3 is the minimum):

- MUT LAC – added 10 stations to the subnetwork;
- OLG LAC – added 10 stations to the subnetwork;
- RGA LAC – added 10 stations to the subnetwork;
- WUT LAC – added 12 stations to the subnetwork.

Currently all stations are processed by 4 or 5 LACs (except for the AUT1, MATE and ZIMM which are processed by 6 LACs).
Time series of BBYS station coordinates
Time series of CPAR station coordinates
Thank you for your attention!

http://www.epnacc.wat.edu.pl/

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