Alberding solutions for GNSS infrastructure operators

Tamás Horváth
Alberding GmbH

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14-15 November 2016, Prague, Czech Republic
Outline

About us

Alberding GNSS Status Software

Alberding-QC

Alberding DataConv
Alberding GmbH

- German GNSS software and hardware development company
- Based in Wildau (near Berlin)
- More than 20 years of experience in high-accuracy GNSS positioning
- Specialised in GNSS data communication, management, processing and monitoring
- Customised solutions for GNSS infrastructure operators
- Independent from GNSS receiver manufacturers
Alberding GNSS Status Software

- **Central GNSS data management**
  - Real-time data collection
  - RINEX logging (v 2.11, v 3.0x)
  - Real-time data redirection (TCP, Ntrip)

- **Data processing modules**
  - Real-time positioning (DGNSS, RTK, PPP)
  - Post-processed PPP positioning
  - DGNSS VRS networking
  - Atmosphere modelling

- **Web interface**
  - Visualisation
  - Alarming
  - Reporting
Alberding GNSS Status Software

• **Application areas:**
  – GNSS observation data quality monitoring
  – External sensor data monitoring
  – GNSS reference station antenna position stability monitoring (post-processed PPP)
  – DGNSS/RTK/PPP service quality control
  – Monitoring of atmospheric processes
• **GNSS observation data quality**
  - Raw data availability, latency, completeness
  - Number of satellites
  - DOP values, skyplot
  - Multipath
  - Cycle slips
  - Signal quality \((C/N_0)\)

• **Position quality**
  - Accuracy \((N,E,H)\)
  - Statistical values

• **External sensor data**
  - Weather station
  - Tilt sensor
  - Geotechnical sensors

• **Troposphere**
  - Zenith Total Delay
  - Integrated Water Vapour
Observation data monitoring

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# Observation data monitoring

![Observation data monitoring](image)

### Status information --- System Time: 11-11-2016 08:36:01 (UTC)

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Observation data monitoring

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Observation data monitoring

- Air pressure
- Humidity
- Wind azimuth
- Wind speed
- Rain increment
- Hail indicator
- Tilt north
- Tilt east

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Observation data monitoring
Observation data monitoring

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<th>HDOF (Time)</th>
<th>VDOF (Time)</th>
<th>PDOP (Time)</th>
<th>TEC Pre (Time)</th>
<th>PRT (Time)</th>
<th>H hor (Time)</th>
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RINEX and raw data logging
Post-processed PPP monitoring

• Reference station coordinates
• Independent from the RTK networking algorithms
• Post processing of 24h RINEX files
• Web based status monitoring
• History data on time series plots
• Comparative analysis, differential plots
• Customisable alarm generation
Troposphere monitoring

- Real-time Precise Point Positioning (PPP) based troposphere estimation
- Tropospheric Zenith Total Delay (ZTD)
- Integrated Water Vapour (IWV)
Troposphere monitoring

- ZTD and IWV time series plots

- Temperature and pressure differences

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Troposphere monitoring

- Real-time ZTD, IWV, temperature and pressure surface maps

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ZTD validation with Bernese V5.2

Bernese ZTD data provided by FÖMI SGO, Hungary

Mean [m]: -0.002
SD [m]: 0.011
ZTD validation with Bernese V5.2

Bernese ZTD data provided by FÖMI SGO, Hungary
ZTD validation with Bernese V5.2

Bernese ZTD data provided by FŐMI SGO, Hungary

Mean [m]: 0.014
SD [m]: 0.011

Bernese data provided by FŐMI SGO, Hungary.
# ZTD validation with Bernese V5.2

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ZTD validation with CSRS-PPP

**ZTD - SULP**

- CSRS
- Alberding

**Mean [m]:** 0.002
**SD [m]:** 0.009

**Delta ZTD - SULP**

- CSRS - Alberding
Alberding-QC – service monitoring

• Quality control software for DGNSS, RTK and PPP service providers
• Multi-purpose tool: 3 modules integrated into a single web interface
• Monitors service availability, accuracy and data contents
• Software licence or service provided by Alberding GmbH
Alberding-QC software modules

RTK-Check
- Positioning accuracy and ambiguity fixing time

Checkstream
- Ntrip stream availability and data consistency

InspectRTCM
- GNSS binary data decoding and visualisation
RTK-Check concept – physical station

- Ntrip Caster
- RTK corrections via TCP
- Correction data forwarding
- NMEA data analysis
- Mean of the best quality epochs
- Statistics computation
- Visualisation of the results
- Warnings (email/SMS)

AQC

RTK-Check

Physical GNSS monitor station

- RTK corrections via TCP
- Connection sessions
- NMEA position via TCP
- RTK position computation
- Receiver FW
RTK-Check concept – internal process.

- GNSS raw data streams
- Ephemeris data stream

Ntrip Caster

AQC RTK-Check

- Internal data processing in sessions (RTKLIB)
- NMEA data analysis
- Statistics computation
- Visualisation of the results
- Warnings (email/SMS)
RTK-Check features

- Compare different solutions
  - Different baseline lengths
  - Different processing techniques
  - Different receiver/software settings
- User defined connection intervals
- Real-time, epoch-by-epoch analysis
- Customised warning thresholds
  - No NMEA data
  - No RTK Fix
  - High position error
  - Low number of SVs
  - High data age
- PDF reports, CSV export
RTK-Check web interface
RTK-Check history data analysis
Checkstream – Ntrip monitoring

• Ntrip Caster server and Ntrip stream availability monitoring
• Periodical data sampling
• Data decoding - format verification (RTCM, CMR, raw data)
• Data content analysis – message types and update rates
• Data age analysis
• Monitoring multiple casters from a single website
• Monitoring hundreds of Ntrip mountpoints
• NMEA output for network RTK streams
• Availability statistics for 24/7 and normal working hours
• Automatic email/SMS warnings with flexible settings
• PDF reporting
Checkstream – web interface
InspectRTCM

- GNSS binary data decoder software for detailed data content analysis

- Real-time visualisation
- RTCM, CMR, RTCA, raw binary input
- NMEA GGA output for network RTK streams
- Transmission delay analysis
- Data rate analysis of individual message types

- Real-time streams (TCP/UDP/Ntrip/serial) and file input
InspectRTCM web interface

![InspectRTCM web interface screenshot]

**InspectRTCM**

*Time Zone: 2014-06-30T12:58:51 UTC*

### Inspect-Stream

- **Connection-String**: http://WLD_RTCM2/checkstream/pw1(pwd123@tdip.dgpsonline.eu:2101)
- **ntrip.mountpoint=** / [username] [password] [server] [port] [name] [sec]
- **top server** [port]
- **server [baud [bit parity stop protocol] [device]]

### Correction-Input

- **Data-Rate**

#### Check successfull

### Inspect-File

- **Inspect File**: Choose File, No file chosen

### Output

- **RTCM** (2014-06-30T12:58:54.61 delay 1.0s) Type 18: ID=560, zone=2349.6, SegId=7, block=19, 
  - *Health=UQRE Scale Factor 1*, incontinuing detected
  - **FrequencyL1**: Time of measurement=3580.00000000
  - **SV-5**, **Multi yes**, *Code==A, Type==GRS, Qual==1*: < 0.03932, Loss=18, crp=714665.4958
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Alberding-QC – references

- AXIO-NET (Germany)
- SWEPOS (Lantmäteryet, Sweden)
- AllDayRTK (Position Partners, Australia)
- FLEPOSO (Agiv, Belgium)
- SWIPOS (swisstopo, Switzerland)
- mAXI-NET (Axiál, Hungary)
- ASG-EUPOS (GUGIK, Poland)
- SKPOS (GKÚ, Slovakia)
- SIGNAL (GURS/GIS, Slovenia)
- IGN (IGN, France)
• Real-time GNSS data translation

- Leica
- Trimble
- Topcon
- Ashtech
- Septentrio
- Javad
- NovAtel
- Hemisphere GPS
- U-blox
- NVS
- etc.

Raw data \[\rightarrow\] DataConv \[\rightarrow\] RTCM, CMR, RINEX

- RTCM 2.x
- RTCM 3.x
- CMR
- CMR+
- RINEX 2.11
- RINEX 3.0x
Alberding DataConv

- Real-time GNSS data translation

Raw data $\xrightarrow{\text{DataConv}}$ RTCM, CMR, RINEX

RTCM $\xrightarrow{\text{DataConv}}$ CMR, RINEX

RTCA $\xrightarrow{\text{DataConv}}$ RTCM
Thank you for your attention!

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Web: www.alberding.eu