

GNSS CORS Infrastructure and General Principles
FIG Regional Conference

TS 02
GNSS CORS Fundamentals

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GNSS CORS – Infrastructure and Principles

Structure

- Definitions
- GNSS Error Sources
- CORS Network Principle
- Realtime Processing
- CORS Infrastructure
- CORS
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- Conclusions

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GNSS CORS – Infrastructure and Principles

Definitions

- **GNSS** – Global Navigation Satellite Systems
currently:
Global Positioning System (US) and
GLObal NAVigation Satellite System (Russian)
future:
e.g.: Galileo (European) and Compass (Chinese)
- **CORS** – Continuously Operating Reference Station
- **CORS Network** – a network of connected CORS
 - for real time applications
 - for post-processing

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GNSS Error Sources

The diagram shows a satellite in orbit above Earth. A dashed line represents the signal path from the satellite's clock through the ionosphere and troposphere to an antenna on the ground at the 'antenna phase centre'. Labels indicate the 'satellite orbit', 'satellite clock', 'ionosphere', 'troposphere', and 'multipath' (represented by a curved arrow reflecting off the ground).

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Precise Differential GNSS

- Relative respectively differential GNSS delivers high accuracy by using simultaneously measuring Reference (may be a CORS) and Rover
- Elimination respectively reduction of errors partly depends on the baseline length
- Errors sources that show an effect depending on the baseline length:
 - satellite orbit and clock
 - ionosphere
 - troposphere
- Solution: Network Approach !

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Network GNSS Principle

The diagram illustrates the GNSS Network Principle. It shows a horizontal baseline between two CORS stations (CORS 1 and CORS 2) and a central Rover station. A green line represents the 'actual correction' curve, which is fitted to the data points from both CORS 1 and CORS 2. A red line represents the 'rover correction in CORS network', which is only applied at the Rover station. A blue line represents the 'linear interpolated correction surface', which is only applied at the CORS 1 station. A small green segment at the end of the green line is labeled 'small remaining error'.

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Classification of GNSS CORS Networks

- ...with respect to accuracy

- code solution = DGPS networks
- phase solution = PDGPS networks

- ...with respect to data availability

- real time solution
 - = Real Time Kinematic (RTK) networks
- post-processed solution
- raw data for post-processing

Focus on PDGPS with different data availability !

GNSS CORS Network Realtime Processing (1)

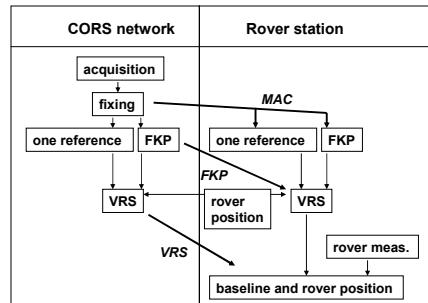
- Acquisition of all measurements within the network,
- Fixing of the ambiguities within the network,
- Determination of area correction parameters (FKP),
- Generation of measurements for one reference station,
- Estimation of the measurements for a virtual reference station (VRS) by the use of the approximate position of the rover,
- Determination of the baselines and finally the rover position using the rover measurements.

GNSS CORS Network Realtime Processing (2)

Three Concepts

- VRS – virtual reference station
- FKP – area correction parameters
- MAC – master auxiliary concept

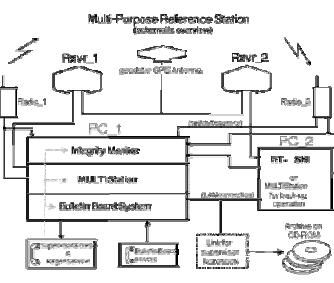
GNSS CORS Network Realtime Processing (3)



GNSS COORS Infrastructure

- GPS / GNSS receiver and antenna
- Power supply
- Computer for data storage, data transmission and control of the receiver
- Data transmission / communication with the user via:
 - radio communication
 - mobile network e.g. GSM
 - satellite
 - internet (NTRIP = Network transported RTCM via internet protocol)
 - fixed line telefon network (post-processing only)
 - internet using RINEX format (post-processing only)
- Software to generate the output for users (RTCM or RINEX format)
- Optional: complete second system for back-up

GNSS COORS Infrastructure



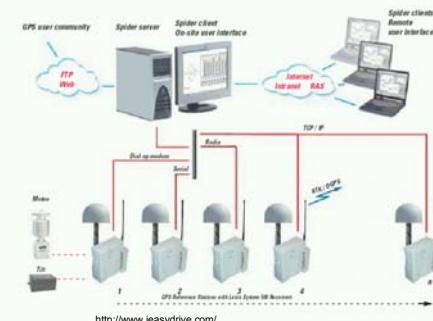
<http://www.leica-geosystems.com/>

GNSS CORS Network Infrastructure

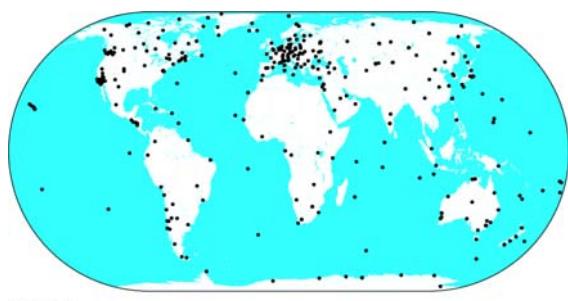
- Additionally to GNSS CORS infrastructure communication between the CORS respectively to a computing centre has to be realised; e.g. by radio communication, internet, mobile or fixed line phones.
- Software to compute network solutions (e.g. fixing the ambiguities) and generate output for users (RTCM or RINEX format) as well as FKP or VRS.

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GNSS CORS Network Infrastructure

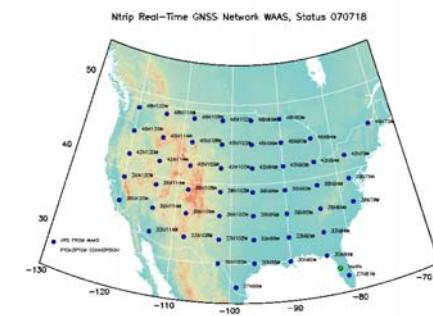


Examples – IGS (PDGPS raw data)

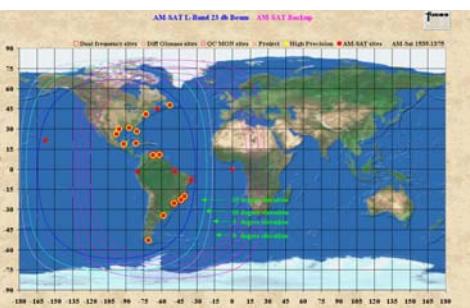


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Examples – WAAS (DGPS real time)



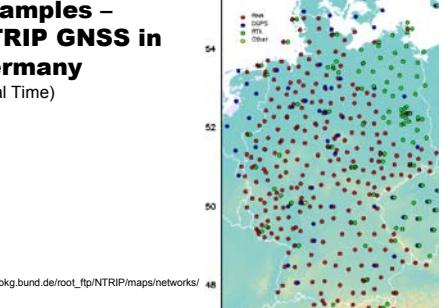
Examples – Omnistar (PDGPS / DGPS real time)



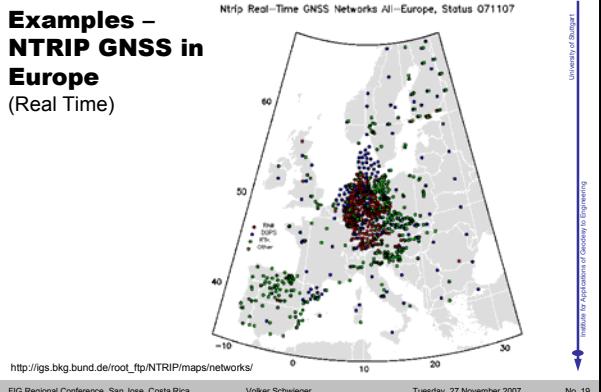
Part of the network:
south and central America

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Examples – NTRIP GNSS in Germany (Real Time)



Examples – NTRIP GNSS in Europe (Real Time)



http://igs.bkg.bund.de/root_ftp/NTRIP/maps/networks/

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Conclusions

- CORS are available 24/07
- Strong correlated errors are eliminated by differential GNSS
- Network approach additionally reduces baseline length dependent errors
- Infrastructure for post-processing applications works without problems world-wide
- Real time networks are in operation too
- Main Advantage:
User needs only one GNSS receiver for positioning !

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Thank you very much for your attention !

CONTACT

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