Practical Test on Accuracy and Usability of Virtual Reference Station Method in Finland

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Implementation of the measurements

VRS Networks:
- Tampere
- Geotrim Ltd.

Test fields:
- Tampere region
- Southern Finland
- Srjokull photographic test field
- Neighborhood of the FGI

Criteria for test points:
- No obstructions above 20 degrees
- No reflecting surfaces and nearby electrical installations in the vicinity of the antenna
- Benchmark on bedrock or stable rocks or structures
- Benchmarks with known EUREF-FIN coordinates
- Distances to nearest reference station evenly at whole measurement area

Results in general

Subjects
- Test areas and networks
- Results
- Equipment-related factors on results
- Network related factors on results

Results:
- Each test point measured 3-4 times under different satellite geometry
- Independent initialisations for all observations
- Accuracy and initialisation times on qualified VRS system
- Failed initialisations: 1.8% (>10 minutes)
- 4 gross errors proportional to chosen initialisation reliability (99.9%)

Distances between network stations (density of network)

4 differently formed networks during four weeks, almost simultaneous observations from test and reference network
- Mean distances: 67km, 77km, 87km and 107km (reference: 61km)

Each bar represents 300 independent observations
- Difference of red and blue bars is the influence of spacing the network
- Mean distance below 80km safe

Number of network stations

- Large network, practically no distance correlation
- Small network, no difference to large network in plane coordinates but for height and initialisation times clear correlation to distance visible

Other tests:
- Baseline length
- Rover position
- Number of satellites, satellite geometry
- Number of epochs
- Surroundings (obstructions)
- Temporal variation of fixed solution
- Equipment
- Atmosphere

Criteria for test points:

Distances to nearest benchmarks with known EUREF-FIN coordinates

Mean in influence of spacing the network

Values of each criterion:

- RMS
- Average
- Plane (mm)
- Height (mm)
- Initialisation time (s)

99% 66 100 396
95% 43 67 132

Each test point measured 3-4 times under different satellite geometry

Equipment-related factors on results

Measurement factors on results

Network related factors on results

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Summary

- VRS suitable for centimetre-level measurements with high reliability
- Reliability of solution proportional to chosen reliability of initialisation
- Number of network stations influences on height accuracy and especially on initialisation times
- Adequate mean distance between reference stations < 80km

THANK YOU FOR YOUR ATTENTION