

Performance Assessment of a GPS Network RTK Service

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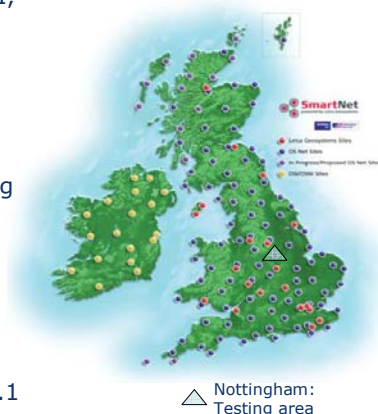


- Objectives
- NRTK GPS Service: Leica SmartNet
- Assessment Methodology
- Quality Measures:
 - Accuracy and Precision
 - Availability of Accuracy
 - NRTK Availability
 - Repeatability
 - No. of GPS Satellites and DOP
- Conclusions

- Assess performance of SmartNet service from end user's point of view, based on:
 - Accuracy
 - Precision
 - Availability of Accuracy (better than 5 cm)
 - NRTK Availability
 - Repeatability
 - Number of GPS satellites and DOP

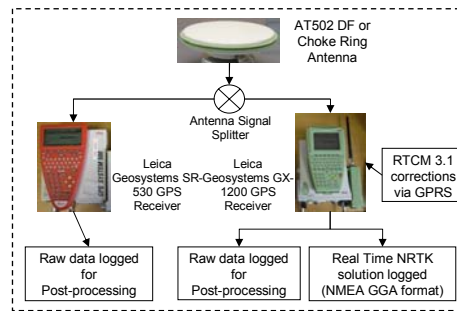
NRTK GPS service for Great Britain and Ireland:

- Partnership: Leica Geosystems and OSGB, OSI, and OSNI
- 145 RS
 - 16 RSs in Ireland
 - 20 Leica RSs (10 GPS/GLONASS RSs)
- RSs: Leica 500/1200 Receivers and Choke Ring Antennas
- Operational from January 2006 in GB and July 2007 in Ireland
- Leica SpiderNet Software (MAX & i-MAX)
- GPS receivers supporting RTCM formats 2.3/3.1



- Static Tests (TS1, TS2, TS3, TS4.1, TS4.2, TS5.1 and TS5.2):
 - Accuracy, precision, availability and repeatability
- Kinematic Tests (TK1 and TK2):
 - Accuracy and availability
- Influence number of GPS satellites and their geometry, age of the NRTK corrections (AoC)
- TK1 covered a built-up area
- NRTK Service tested "as it is"

Equipment Configuration



Static Tests



Kinematic Tests



Quality Measures: Accuracy and Precision

Accuracy (error), how far the coordinates observed during testing were from the true values

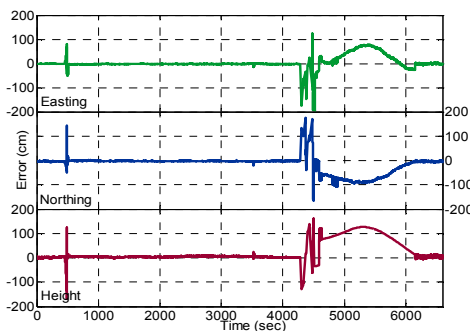
Precision, degree of closeness that repeated measurements displayed (Standard Deviation of the observations, 1 Sigma)

Average Accuracy and Precision Results

Coordinate	Accuracy Average (cm)		Precision Average (+/- cm)	
	All Epochs	NRTK Epochs	All Epochs	NRTK Epochs
East	0.7	1.3	5.4	1.0
North	5.2	3.1	7.4	1.3
Height	4.6	3.2	12.7	2.6

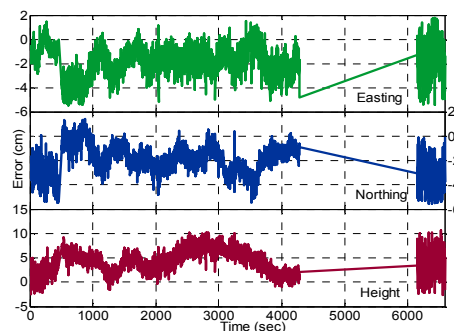
Quality Measures: Accuracy and Precision

ENH Errors during TS4.1



All Epochs

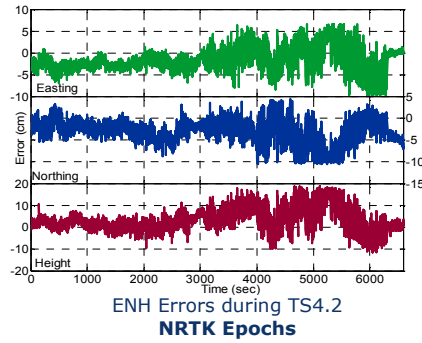
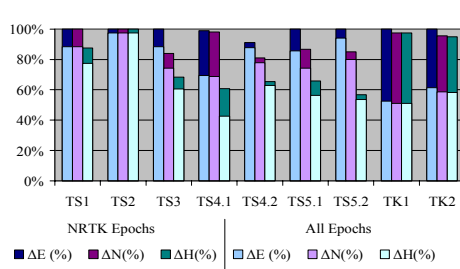
3DRMSE = 30.3 cm



NRTK Epochs

3DRMSE = 5 cm

Availability of Accuracy, percentage of NRTK observations with accuracy better than 5 cm

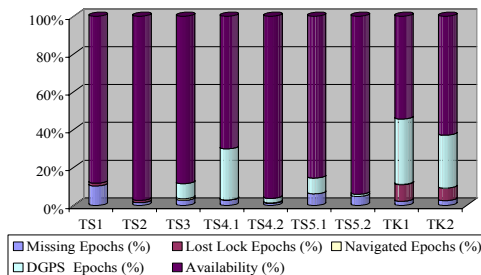


Percentage of observations with errors better than 5 cm

Availability, percentage of observations in which a NRTK solution (integer ambiguities resolved) was obtained

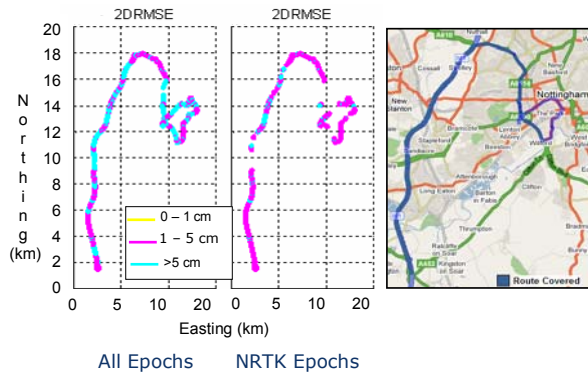
Test	Possible Epochs	NRTK Epochs	Availability (%)
TS1	7200	6356	88.28
TS2	5400	5257	97.35
TS3	28800	25490	88.51
TS4.1	6600	4628	70.12
TS4.2	6600	6354	96.27
TS5.1	10800	9241	85.56
TS5.2	10800	10164	94.11
TK1	93599	50905	54.39
TK2	64799	40736	62.87

NRTK Availability results



Detailed percentage of observations performed under the different solution types during tests

TK1 2D RMSE Errors as Observed in the Covered Route



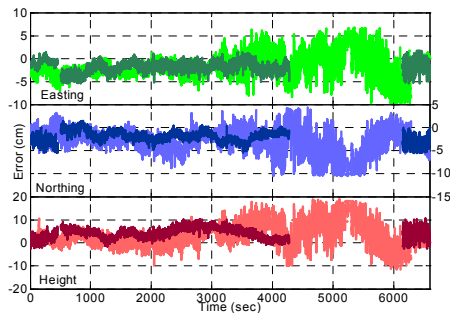
Factors Affecting the Availability during the Kinematic Tests



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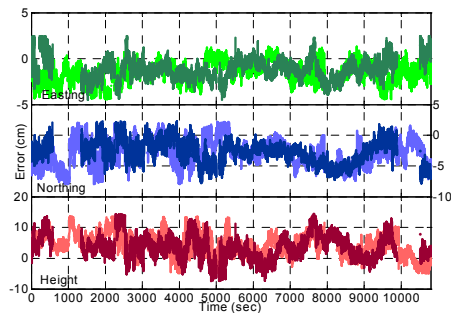
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Repeatability, similarity between the errors obtained during two different tests carried out under similar conditions (NRTK Epochs)



Repeatability between TS4.1 (Dark Colour) and TS4.2 (Light Colour).

4331 common epochs of a total of 6600 (65%)



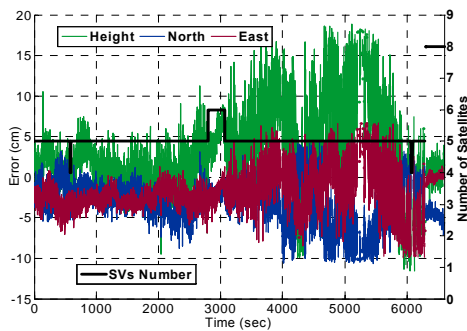
Repeatability between TS5.1 (Dark Colour) and TS5.2 (Light Colour).

8233 common epochs of a total of 10800 (76%)

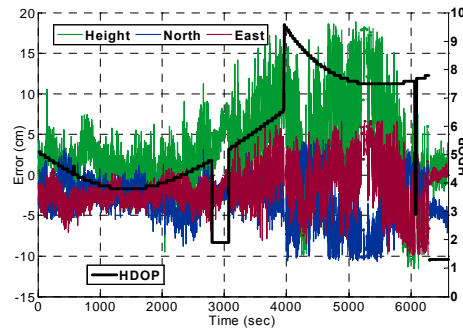
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Influence of No. SVs in solution and their geometry over the positional accuracy



Influence of the No. of GPS satellites in Solution over the Errors during TS4.2 (NRTK Epochs)



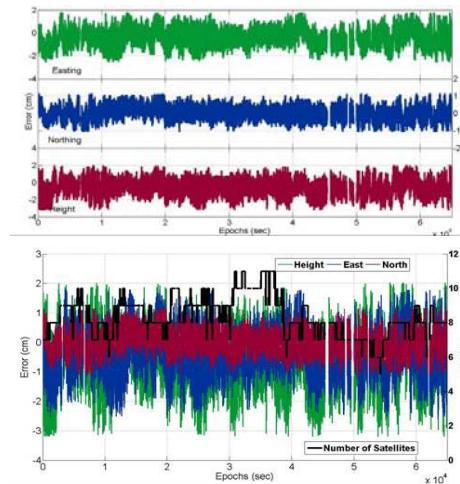
Influence of the HDOP over the Errors during TS4.2 (NRTK Epochs)

- SmartNet (NRTK) can offer high centimetric accuracy (1.27 cm Easting, 3.08 cm Northing and 3.23 cm Height).
- It also achieves high precision (1-sigma) (+/- 0.97 cm East, +/- 1.34 cm North and +/- 2.58 cm Height).
- Availability of the NRTK solution is the main drawback. Centimetric accuracy and precision only achieved during about 90% of the time in static tests and 58% during the kinematic tests.
- Lack of availability mainly due to external factors and not directly related to the NRTK system:
 - GPS signal disturbances (blockage).
 - Low number of GPS satellites in solution and bad DOP.
 - Interruptions of the GPRS communication link.

SmartNet (NRTK) May 08

- 18 hours of connection
- Over 99% availability
- 10° Cut off angle
- 85% of NRTK fixes are within 2cm
- Max error in height = 3.2cm

GPS&GLONASS was not evaluated in tests, however SmartNet now offers GNSS Network RTK services.



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Thank you for your attention

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