FIG Working Week-
Bridging the Gap Between Cultures
Marrakech, Morocco
May 18-22 2011

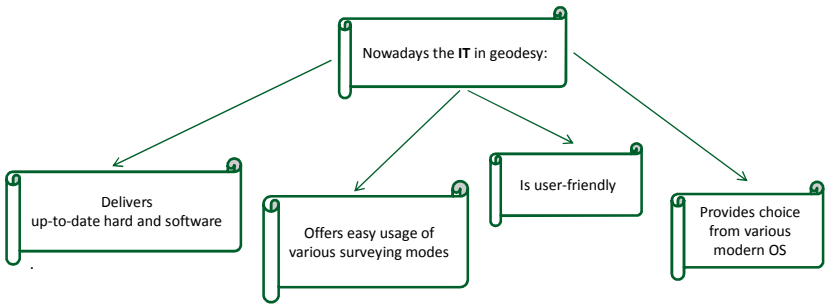
Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

Gintcho Kostov, Bulgaria
"GEO ZEMIA" Ltd.

www.geozemia.com

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

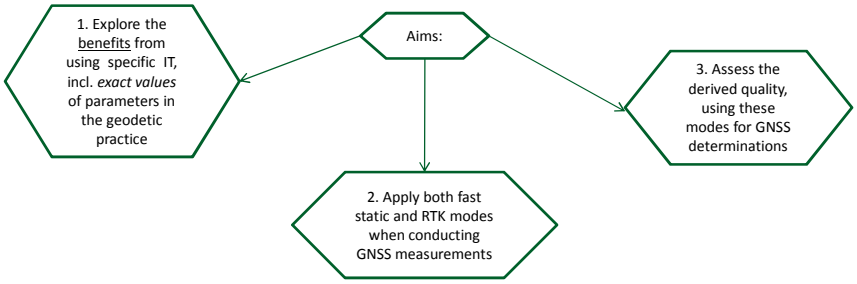
1. Introduction



www.geozemia.com 2

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

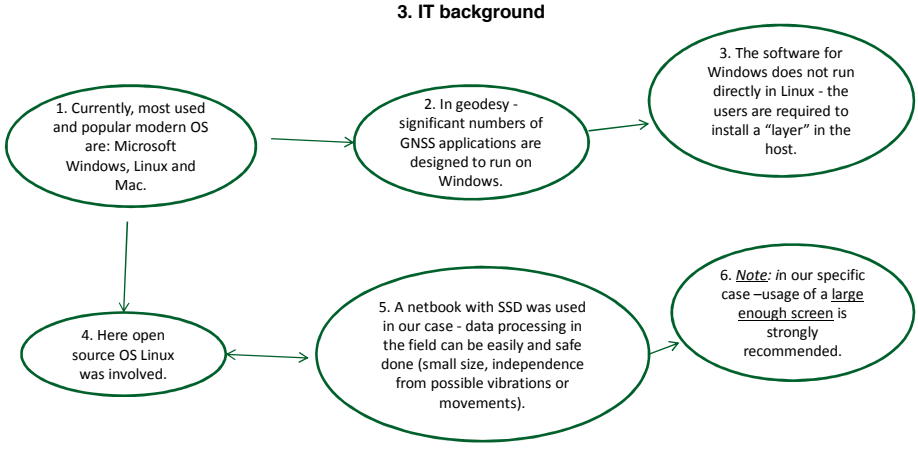
2. Purpose of this paper



www.geozemia.com 3

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

3. IT background



www.geozemia.com 4

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

4. Used modes for GNSS determinations

Known specifics of RTK and fast static modes, which have *strong relation* with this paper:

4.1 RTK mode – advantages:
- Results (coordinates and quality criterion M3D (see chapter 6)) - available immediately;

4.2 RTK mode – disadvantages:
- Dependence from the terrain and environment conditions e.g. forests, urban areas, hills, etc.;
- Long baseline measurements are not preferable;
- Unsure/unreliable data link coverage, when specific terrain conditions exist.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

4. Used modes for GNSS determinations

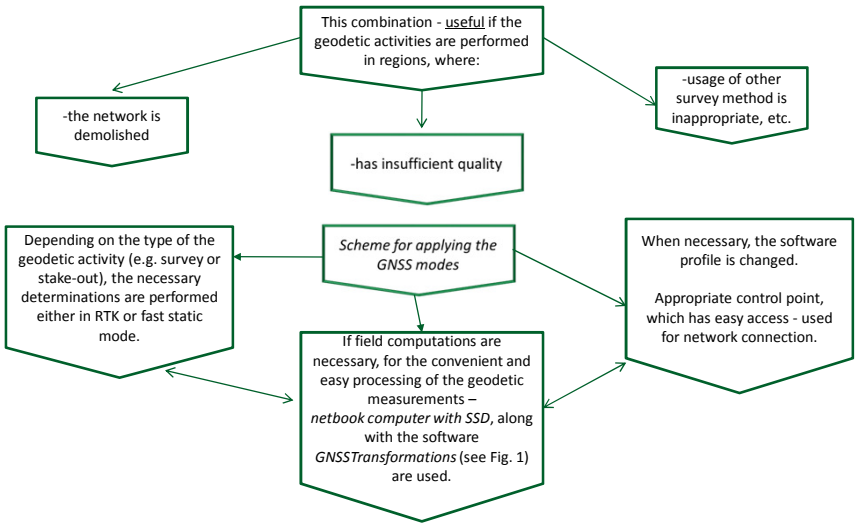
4.3 Fast static mode – advantages:
- Independence from the various environmental conditions between the stations;
- Very high overall accuracy is achieved;

4.4 Fast static mode - main disadvantage:
- Clear horizon required for the stations.

Due to the above mentioned facts, based on chapter 3, one possible combined practical usage of RTK and fast static modes will be described and discussed next.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

5. Usage of both fast static and RTK modes in the geodetic practice



Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

5. Usage of both fast static and RTK modes in the geodetic practice

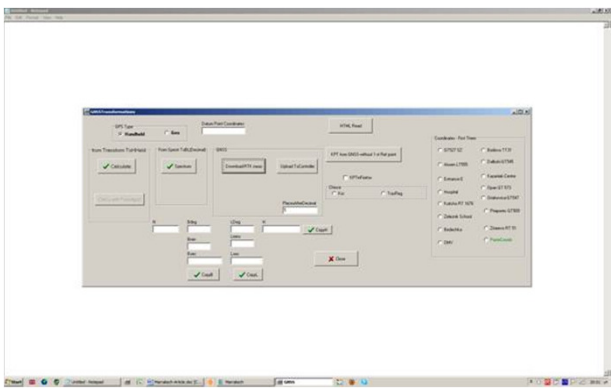
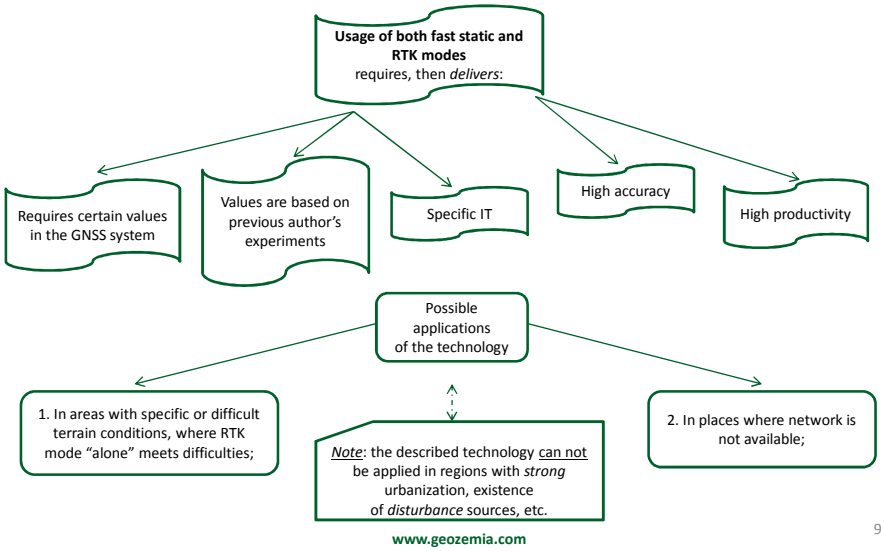


Fig. 1 – Application GNSSTransformations

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

5. Usage of both fast static and RTK modes in the geodetic practice



Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

6. Used Quality Criteria

In this paper the following quality criteria were used:

a) Quality in position and height M_{3D};
b) Elements of the co-variance matrix for the chord: Q_{xx} Q_{yy} Q_{zz}
c) Number $Gdop(\max)$;

d) Number $Pdop(\max)$.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

Using the necessary IT, a number of objects from the geodetic practice were completed.

It should be noted that if applying RTK mode (*in our specific case – along with fast static mode*), the value for M3D criterion reached 9 mm.

Quality assessment from the post-processing, used *within* this technology:

7.1 Fast static mode - applied over baselines with various lengths:

Object "River". Length of the spatial chord 1100 m.

Point ID	M_{3D} [m.]	Qxx	Qyy	Qzz	GDOP (max)	PDOP (max)
777	*0.0004*	0.00000135	0.00000108	0.00000102	1.5	1.4

Table 1

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

Object "Ostra Mogila". Length of the spatial chord 5800 m.

Point ID	M_{3D} [m.]	Qxx	Qyy	Qzz	GDOP (max)	PDOP (max)
100	*0.0007*	0.00000211	0.00000046	0.00000090	**2.0**	**1.8**

Table 2

Object "Stake-out activities". Length of the spatial chord 11700 m.

Point ID	M_{3D} [m.]	Qxx	Qyy	Qzz	GDOP (max)	PDOP (max)
555	*0.0008*	0.00000189	0.00000038	0.00000088	1.8	1.6

Table 3

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

Object "Surveying activities near the boundary". Length of the spatial chord 30600 m.

Point ID	M_{3D} [m.]	Qxx	Qyy	Qzz	GDOP (max)	PDOP (max)
110001	*0.0010*	0.00000646	0.00000319	0.00000602	1.7	1.4

Table 4

In the case – usage of *fast static mode*, the quality criterion M3D has its maximum value of 1 mm. /acc. to firmware/
Taking in mind this, also the values of the DOP factors (which have their maximum of 2 – see table 2), it could be concluded that *high quality* results were derived.

These facts show that the coordinates of the new-determined points from the objects of geodetic activities could be calculated with very high quality - *using specific values of the parameters and nowadays IT possibilities*.

7.2 RTK mode – "experiments":

To explore the *reliability* and *overall quality* of RTK mode with the used IT, several "experiments" were conducted.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

Quality assessment – standalone *RTK mode*:

Object "Priaporec-SZBani" - spatial chord, length 3300 m.

Point ID	Qxx	Qyy	Qzz	M_{3D} [m.]
150100	0.00011064	0.00003138	0.00006143	*0.016*

Table 5

Object "Sarnevec" - spatial chord, length 3889 m.

Point ID	Qxx	Qyy	Qzz	M_{3D} [m.]
2222	0.00003238	0.0000169	0.00003462	*0.011*

Table 6

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

Object "Gradiste" - spatial chord, length 9000 m.

Point ID	Qxx	Qyy	Qzz	M_{3D} [m.]
150100	0.00006554	0.00002714	0.00004038	*0.021*

Table 7

Object "Badeste" - spatial chord, length 9400 m.

Point ID	Qxx	Qyy	Qzz	M_{3D} [m.]
1	0.00001945	0.00001554	0.0000143	*0.020*

Table 8

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

7. Results from the performed GNSS measurements

The quality criterion M3D for the "experiments" in RTK mode has values in the interval [11 21] mm.

According to the results, it could be concluded, that RTK mode could *also be used* for geodetic determinations of coordinates over distances of several thousand meters and to produce good quality results.

It should be noted, that application of *only* RTK mode in our specific case (see point 4.2) is not prefera*ble* and should be *avoided*.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

8. Conclusions. Remarks. Outlook.

Based on the provided data, it could be summarized:

-The IT in geodesy nowadays, especially the current GNSS status provides lots of flexibilities and possibility for producing of high quality results.

-Usage of both fast static and RTK modes, along with the required IT could be applied with success in the practice when high: *accuracy and productivity* are essential for the geodetic determinations.

Outlook - the application GNSSTransformations could be updated with the ability to perform some checks, according to the specifics of the technology.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

REFERENCES:

Kostov, G., 2009, Using of Fuzzy logic for some studies over GNSS determination in fast static mode, pp 3-7, Sofia, UACEG (in Bulgarian)

Kostov, G., 2010, Some Studies on the Quality of GNSS Determinations Under Specific Conditions, FS 1H - GNSS CORS Networks - Positioning Infrastructure, Analysis and Applications I. FIG Congress 2010 Facing the Challenges – Building the Capacity Sydney, Australia, 11-16 April 2010

Minchev, M., Iv. Zdravcev, Iv. Georgiev, 2005, Foundations of the application of GPS in geodesy, pp 112-118, Sofia, UACEG (in Bulgarian)

Valev, G. M. Minchev, 1995, Instruction for determination of coordinates with GPS, pp 12-15, "Cartography" Ltd., Sofia (in Bulgarian)

Wellenhof, B., Herbert Lichtenegger, James Collins, 2002, GPS Theory and practice, pp183, Springer-Verlag/Wien, Austria (in Bulgarian)

www.geozemia.com 18

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

REFERENCES:

WEB:

http://answers.yahoo.com/question/index?qid=20100325093841AAkgs5U
http://downloadpedia.org/Open_Source_Operating_Systems
http://en.wikipedia.org/wiki/Comparison_of_Windows_and_Linux
http://en.wikipedia.org/wiki/Operating_system
http://facility.unavco.org/
http://solitech.bg/novini.html
http://solitech.bg/office-software.html
http://www.bernese.unibe.ch/features.html#TEC
http://www.cepro.com/article/who_owns_the_code_ce_industrys_dirty_little_secret/
http://www.geomax-positioning.com/geomax-ggo-version-20_424.htm
http://www.geomedia.bg/index.php/article:293?PHPSESSID=773ef63cadd79f8931e48c1e36b0dd55
http://www.geonet.bg/services.html
http://www.leica-geosystems.com/common/shared/downloads/inc/downloader.asp?id=12413
http://www.leica-geosystems.com/en/Product-News_934.htm
http://www.low-cost-computing.com/Windows_Applications_on_Linux.shtml
http://www.naviteq.net/bg/1
http://www.smartnet.bg/
http://www.thefreecountry.com/operating-systems/windows-clones.shtml
http://www.unoosa.org/pdf/publications/icg_ebook.pdf

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

REFERENCES:

Used Geodetic Software:

1. Geomax Geo Office;
2. GNSSTransformations.

Using of both fast Static and RTK Modes for GNSS Determinations to Obtain Required high Accuracy and Productivity, According to the Current Possibilities of the IT

Thank you for your attention!

www.geozemia.com 21