A New Methodology for an Automatic Evaluation Procedure of Cadastral GNSS Measurements According to the Surveyors' Regulations

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Motivations

• **Digital Cadastre** – grid coordinates as the main prove in the court.

• Cadastral points’ coordinates should be computed in high accuracy level according to the surveyors’ regulations.

• The SOI goal for cadastral boundary point coordinates – **5 cm in 95%**

Motivations

• The *surveyors’ regulations* instructions might be complex for achieving this pedant goal.

• When licensing cadastral measurements: Surveyor has to deal with the boundary point similar to control point.

• RTK GNSS technology be the T.S of the future.

• Survey agency will suffer from **huge number** of GNSS cadastral projects for licensing.
Motivations

• The **waiting time** for licensing process will be **long** than usual...

• The surveyor might have his **report** after long time with **failed results**.

• Reasons for failing licensing points may be divided into two parts:
  – Low quality of GNSS observations.
  – Poor understanding of the regulations instructions

Motivations

• Most significant factors that affect GNSS observations quality are:
  – **Satellite Constellation** (position and number)

  – Signals Quality: **noises** around the GNSS receivers (SNR)

  – **Distance** between GNSS receivers

  – The location of the receivers: **multi-path** phenomenon
Low unexpected DOPs values

- Most of the survey agency required DOPs values < 5 for accepted GNSS observations.
- Mission planning for the GNSS satellite could help surveyors avoiding period times with low DOPS values:
  
  Surveyors can also watch their GNSS receiver's DOPS while measuring...

Low unexpected DOPs values

- Are these operations sufficient for good DOPs?
Poor understanding of the regulations instructions

- Complex regulations’ instructions leads to:
  - Uncompleted submission data,
  - Incorrect computations...
  - Insufficient consideration for the instructions

Surveyor prepare the final report for submission

Survey agency Validate the report
**MAJOR**

An Automatic Effective Solution Software

- **Major** is designed for helping:
  - Surveyors:
    - For quick preparation of GNSS measurements project final reports for submission against regulations...
    - Minimizing the uncertainty of the report validation results.
    - Understanding their regulations.
    - Managing their GNSS projects in geodetic mentality.
  - Survey agency:
    - Minimizing the validation and licensing process time
    - Maximizing the reliability of the validation

**Major** concept is existed in final patent registration process

**Data input**

1. Data Input (Processed Vectors, Nash, RTK) CR, PR, PRT, PNR, TRM

**Editing data:**
Defining points types, known coordinates

2. Edit Input (Point Name, Point Cases, and Control coordinates)

**The main algorithm:**
Defining your own regulations

3. The main algorithm
   - Calculation Method
   - Weight
   - Adjusting
   - Known Coordinates
   - Coordinates in Your PK System
   - Converting
   - Known Parameters
   - Known Points
   - Known Coordinates
   - Known PK System

**Choose your desired method and run report**

4. Run the calculation method and generates a detailed Regulation/Report
Example

Israeli VRS method as a study case

• Every New horizontal and vertical control point must be linked to the Active Permanent GNSS station Array

• The example method is one of several methods designated for licensing S1 degree New Horizontal Control points (NHC)

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Israeli VRS method as a study case

1. Every NHC point must be measured against two different VRS.

2. Between two measurement sessions:
   - Minimum 60 minutes
   - 5 cm - Antenna height

3. VRS points < 5 km from each NHC.

4. At least one Checker points linked directly to one VRS.

5. The difference between the measured and computed IG2005 coordinates and its licensed coordinated < 4 cm.
Israeli VRS method as a study case

6. The distance of the checker point < 10 km from every NHC.

7. The distance computed from the coordinates’ differences between the two independent VRS sessions of every NHC < 2.5 cm level.

8. The GNSS PDOP single station measurements values for each point < 5 level during minimum 15 continuous minutes.

9. The GNSS PDOP multi-station vector values for each vector in the net < 5 level during minimum 15 continuous minutes.
Summary

- **Major**: automatic computation and validation of the regulations' instructions.

- Several regulations instructions' method exist in the **Major** library.

- **Major** has several automatic cadastral-geodetic-oriented features such as:
  - Automatic weighting method for RTK vectors.
  - Point description
  - Library licensed control points

Summary

- New method could be generated and added to the library - **Major** suitable for all other countries.

- Rinex module could be work as stand alone for validate the GNSS observation directly when getting reports.

- The **Major** is designated for web-base cadastral report automatic management system.

- Integrated work between surveyors and survey agency using **Major**:

  ![Establishment of high accurate and reliable digital cadastral database]
Thank you for your attention...