NATIONAL UNIVERSITY OF UZBEKISTAN

NAMED AFTER MIRZO ULUGBEK

REPORT

on online study in the frame of the Erasmus+ DSinGIS project

(Fabruary 10 – April 10, 2021)

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Mentor: Dr. Lorant Foldvary

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Due to the pandemic, we were not able to travel to study in EU. The local coordinator informed that at the online meeting, all partners agreed to conduct these studies online.

In this regard, I asked Dr. Lorant Foldvary (Departments of Geodesy and Surveying, Budapest University of Technology and Economics, Műegyetem rkp. 3, 1111 Budapest, Hungary, foldvary.lorant@emk.bme.hu) to prepare a scientific paper. Research topic: Experimental research of the methods and accuracy of engineering and topographic surveys

Dr. Lorant Foldvary then gave his opinion on my research topic and asked the following questions.

"For me this topic is too general.

My questions:

- Is the analysis based on actual measurements? Do you have some measurements to process, or do you plan to make some measurements?

- Which measurement techniques do you plan to include in this analysis?

- Do you have an actual idea where to publish it?

Let' continue the discussion, and then finalize the research plan!"

The answers I gave to the questions are given below.

"Yes, this analysis is based on actual measurements. I have fixed 7 points around the university in recent days. And I made measurements in them in RTK mode with a GPS receiver. Then I made measurements at the same points with a Trimble M3 total station. Now we process them and find the coordinates of the points. Accuracy is assessed. Which method is most effective in finding the coordinates of the points?

I plan to publish this paper at the GISCA-2021 conference."

Then Dr. Lorant Foldvary sent me his suggestions by email.

"Can you extend the research? My suggestions:

(1) accuracy test: based on using different measurement techiques, determine the accuracy of the different methods

- survey with M3 total station

- GNSS RTK

- precise leveling (it can be the reference for comparison of height measurements)

- static GNSS survey (for 12 hours or so, it can be the reference for comparison horizontal measurements)

(2) repeatability test:

- perform each observations 4-5 times, then you can prepare a statistics how much the results are consistent

What is the deadline for GISCA-2021 paper submission?"

The answers I gave to the questions are given below.

"Yes, of course, I can extend the research. And I accept your suggestions.

I have already measured by accuracy test with the M3 Total Station and GNSS measurements in RTK.

Measurements for the next accuracy test are scheduled to be made this week.

Deadline for GISCA-2021 paper submission: May 15, 2021"

I performed a series of measurements with various geodetic instruments based on Dr. Lorant's recommendations

Dr. Lorant Foldvary asked for information about the status of my research. He would like to ask me to have a zoom chat in the following days.

His suggestion for a zoom meeting: Friday, 15:00 Uzbek time.

After our zoom meeting, Dr Lorant Foldvary made the following suggestions.

Based on our zoom meeting, I have built a plan, how to process the measurements. It is very important, that you repeat your measurements minimum 3 times (3 epochs) both with RTK and Trimble M3 and precise levelling! The 3 measurements is denoted to refer to 3 different epochs, t=1, 2, 3, and we assume that no deformation between the epochs change the position of the points (so the points are fix in time).

(1) Adjustment of repeated measurements

After you have the repeated measurements, please process them (separately for RTK and Trimble and precise levelling) to receive coordinates (X,Y,Z)! When you have the coordinates (X,Y,Z) for all the epochs (t=1, 2, 3), you can calculate the „error effect of repeatability".

$$\text{expected value: } X_{mean} = \frac{\sum_{t=1}^{3} X}{3}$$

$$\text{standard deviation: } \sigma_X = \frac{\sum_{t=1}^{3} (L_{mean} - X)^2}{3}$$

The same calculation should be done with Y and Z coordinates as well. This way you can determine the accuracy of the different measurement techniques.

(2) From this step, we are using only the adjusted coordinates and their standard deviation of each point. Then we create a comparison table.

The reason I would refer to the ΔZ differences with respect to precise levelling is that presumably I assume that the standard deviation of the repeated precise levelling measurements are orders of magnitude better than the standard deviation of the GPS RTK and of the total station measurements. If it is not the case, then we should reconsider this Table.

(3) Hypothesis test

Now that we have different solutions with different measurement techniques, we should judge whether their result can be considered to be identical. For this, we have to use different hypothesis tests, depending on which quantities are compared.

The following e-mail from Dr. Lorant is given below:

Below this e-mail you can see my suggestion for the table of content of the GISCA paper. There are also some comments on the different sections. Note, that this is just the concept now, during writing the paper and understanding the results, it may change.

Table of contents of the GISCA paper:

Title: Comparison of the reliability of the most frequently used surveying techniques

Abstract (we will write it only when the paper is completed, since it contains a short summary of it, usually it is based on parts of the 1. Introduction and 7. Discussion)

1. Introduction (this section is about the introduction of the background of the performed analysis, and also the motivation, why we have decided to do this research; we can complete it later)

2. Establishment of a test network (this section provides a desctiption of the network, also a sketch of the network should be included as a Figure)

3. Used instruments (just short introduction of the used instruments, technical informations such as accuracy. No need of picture of them)

4. Measurements (it just explains shortly the measurements: with which method when it was done. Such informations can also be summarized in a Table).

5. Comparison analysis (I will explain the theoretical background)

6. Results (here in Tables the outcome of the different calculations can be included)

7. Discussion (we will write it after the Results are presented)

Acknowledgement (here we should thank for the DSinGIS project)

References (all literature used in the study will be listed here)

According to our discussion via zoom meeting, we finished writing our paper. With the help of Dr. Lorant, an article on my research for the GIS-KA conference was prepared in English and sent via the link https://survey123.arcgis.com/share/7522cf52661241c59ad2daf691d7b0ec

I participated in the annual XV “GIS in Central Asia” Conference - GISCA 2021 (theme: "From spatial data to spatial infrastructure") (May 3-June 2).

Due to the increase in the number of speakers at the Tashkent session, on 02.06.2021 I attended the Dushanbe session with my presentation.

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I would like to thank Dr. Lorant Foldvary, the co-author of the paper, for his help in organizing the research and developing their results.