STUDY ON THE MINIMUM AND MAXIMUM NUMBER OF GROUND CONTROL POINTS ON THE WHEN MAKING AN ORTHOPHOTO PLANE

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Overview

Introduction

- In January 2022, the National Center for Cartography in Romania launched a tender for the realization of a photogrammetric flight for 170 localities, respectively cities, municipalities and county seat municipalities. Each locality constitutes a photogrammetric block.
- One of the conditions imposed by the Terms of Reference was related to the number of GPC ground control points.
- Through this paper we would like to demonstrate that the number of field control points required through the Terms of Reference is too high compared to what is needed.

Problem

01 - number of points/block

Type Cities	Mandatory points distribution	Minimum points/block
County seat municipalities	2 GCP/ corner block + 2 GCP middle block	20
Municipalities	1 GCP/ corner block + 2 GCP middle block	10
Cities		

02 - distribution of the check points

Type Cities	Mandatory points distribution	Minimum points/block
County seat municipalities	1 pct/4 kmp	20
municipalities		10
Cities		

Case study

Area

We chose the city of Ștei, Bihor county, for the study. The area of the block was 60856 square kilometers.

Plane

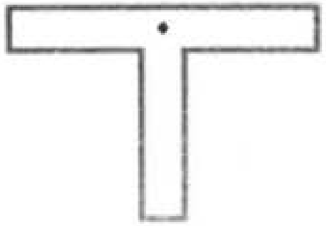
The flight was made with a CESNA 402 B airplane.

Camera

The photogrammetric camera was of the UltraCam Eagle Mark 3 type, 431S61680X916102-f100 and the flight height was 3931 meters. The pixel size 15 centimeters for towns as Stei.

Marking

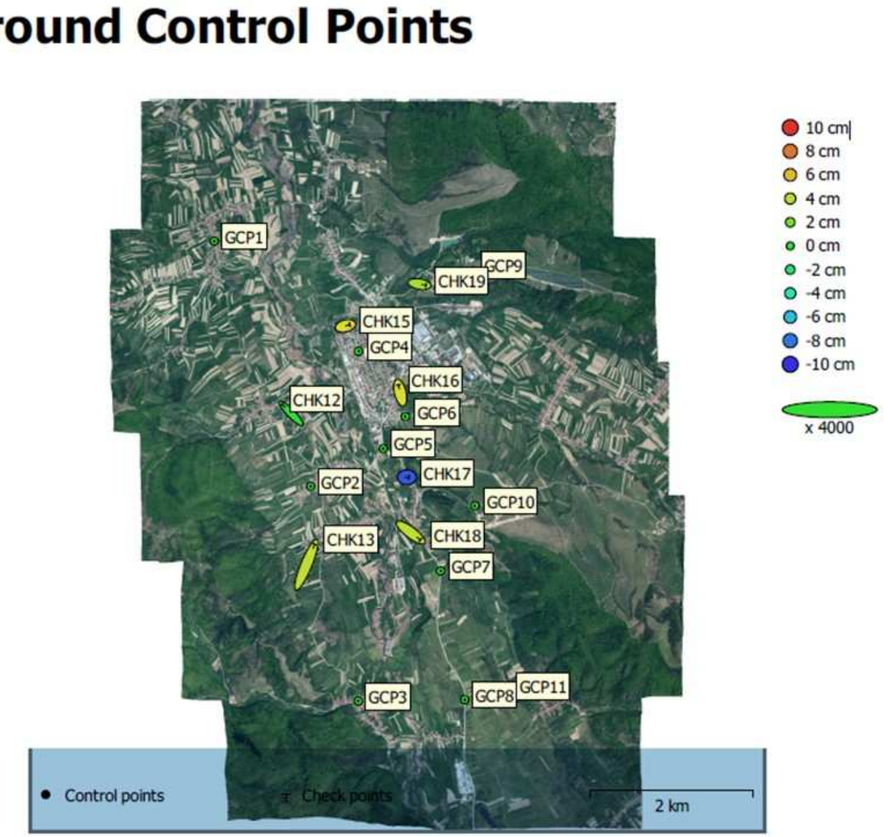
The method of pre-marking the GCPs is of the letter T type. The size of the pre-mark is 15x10 square centimeters.



Carrying out GCP preliminaries and field measurements

Making pre-markings

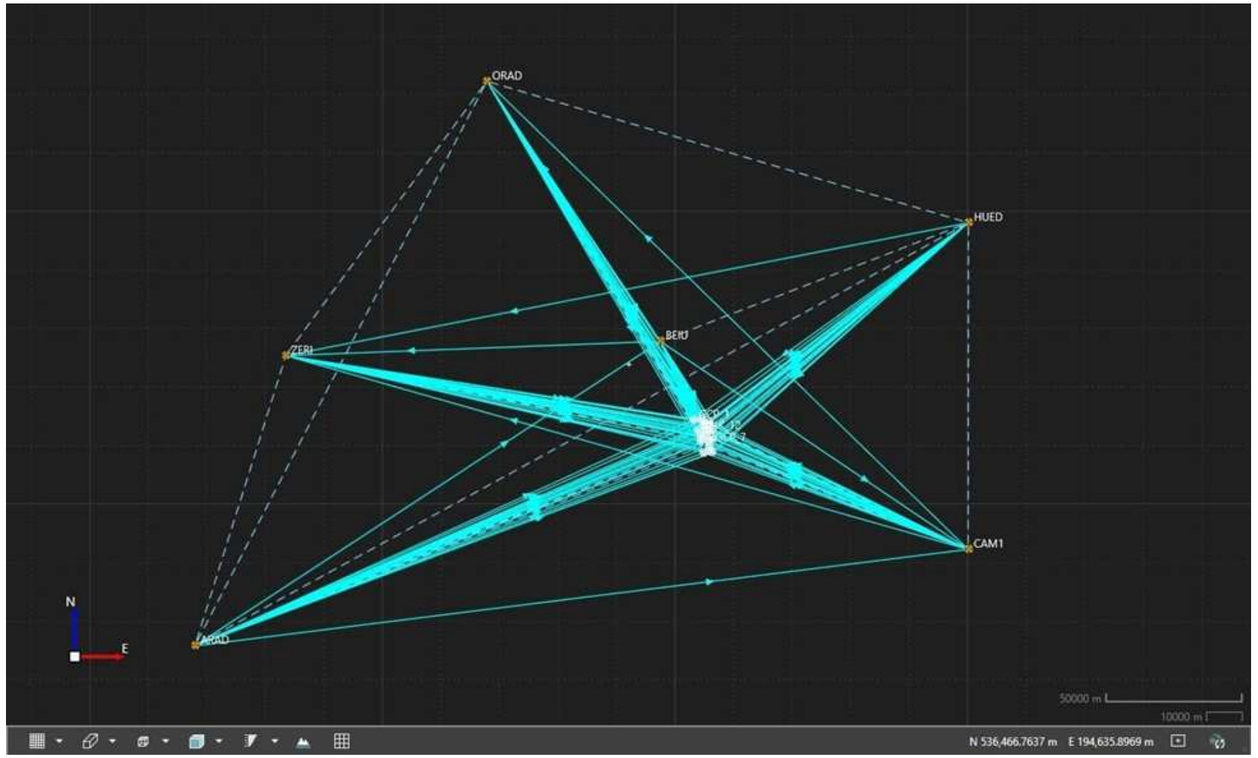
- 11 GCP points (GCP1,...GCP11)
- 6 CHK type points (CHK12,...CHK19)
- the conditions required in the specifications regarding homogeneous distribution and compliance with the minimum distance from the projection center of each frame were taken into account.
- all 17 points were pre-marked a week before the flight, taking weather conditions into account.



Carrying out GCP preliminaries and field measurements

Field measurements

- position determination with GNSS technology, each point was stationed for two hours, creating a network link to the permanent stations of National Agency of Cadaster and Land Registration (ANCPI)
- 6 permanent station were used as points with known position
- altitude determination by high-precision leveling with a connection to the national altimetric network
- the closest two points in the national network were transmitted



Processing measurements and obtaining the ortophotoplan

Processing measurements

The processing was done with the program LEICA INFINITY.
The largest total error is obtained was below 5 centimeters, corresponding to the accuracy required by the Specifications of ± 5 centimeters on each axis.

Obtaining the ortophotoplan

Agisoft Metashape Professional

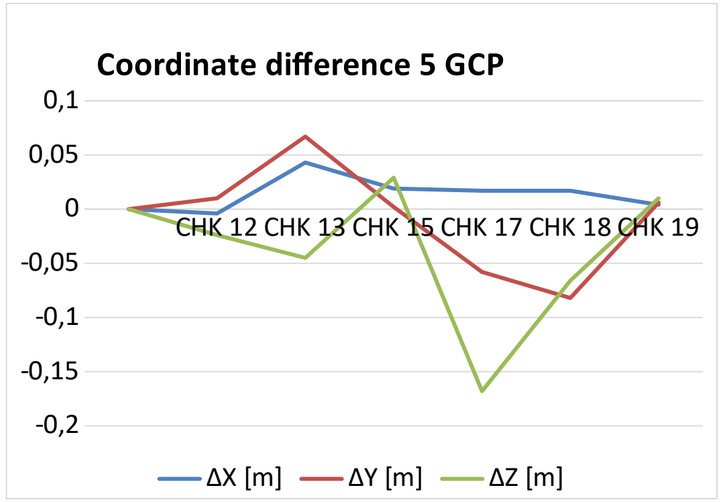
- in three variants: 11 GCP, 8 GCP and 5 GCP

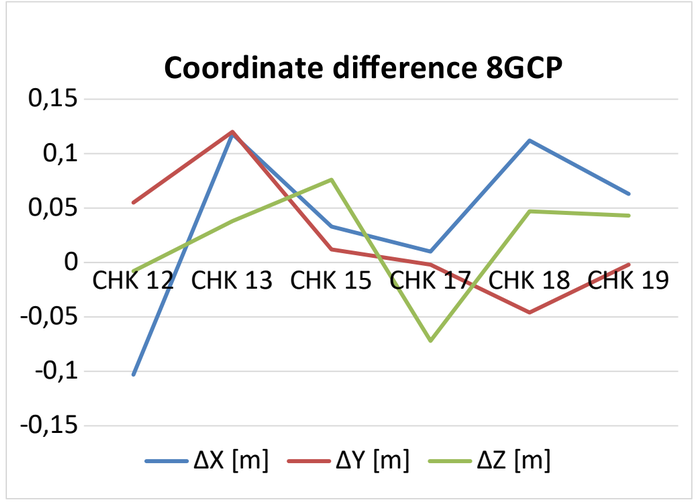
Trimble INPHO

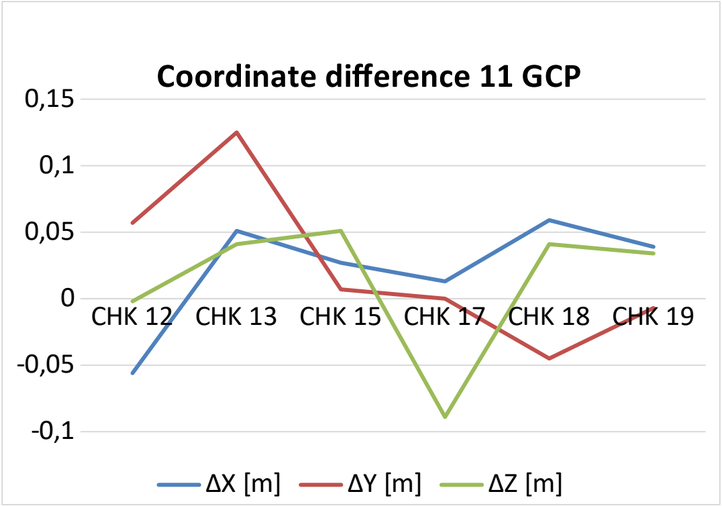
- in three variants: 11 GCP, 8 GCP and 5 GCP

Results

Agisoft Metashape Professional

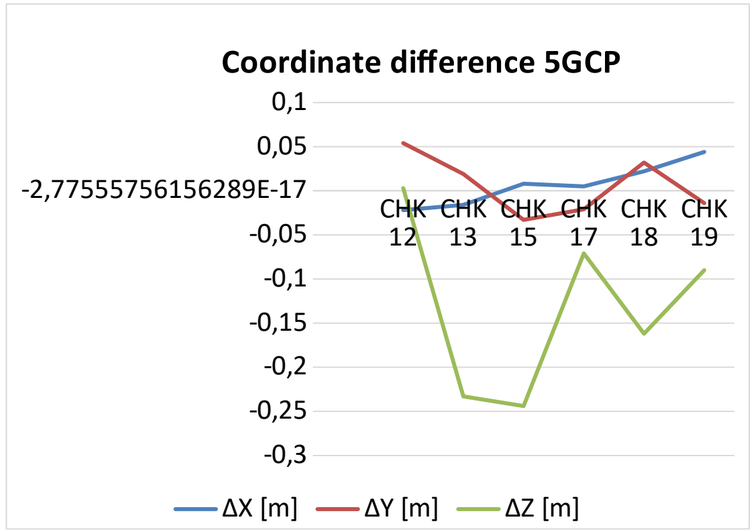


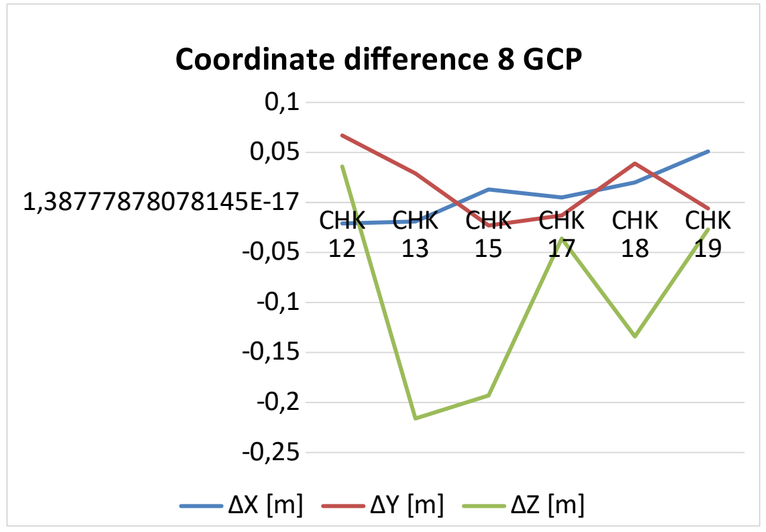


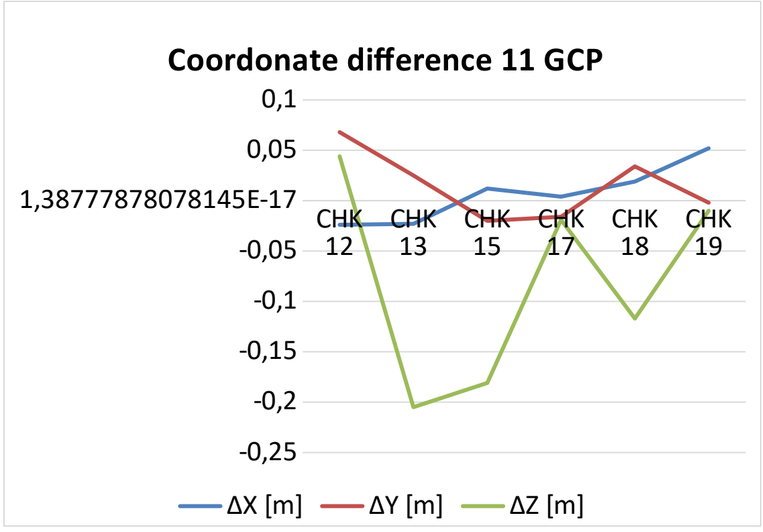


Results

Trimble INPHO







Conclusion

Analyzing the RMSE, reveals the accuracy of orthophotoplanes and digital models against check points. Assuming a maximum ground point error of 5 centimeters and a pixel size of 150x100 square centimeters, models using Agisoft Metashape Professional show better accuracy than those using Trimble INPHO. In the analysis, we start from the idea that the error of the points determined on the ground is a maximum of 5 centimeters. Also, the pixel size is 15x10 square centimeters. The possibility of scoring is thus limited to these dimensions.
Agisoft's largest error is 0.08015 meters on the X axis with 8 GCPs, while Trimble's is 0.1743 meters in elevation with 5 GCPs. Despite this, Trimble's results align better with the pixel size.
Given the pixel size the correct values would be those obtained with Trimble INPHO software
For creating an inner city orthophoto plan, 5 field control points are deemed sufficient for the required precision.

Thank you!

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