INFLUENCES OF THE CAMERA IN THE DETERMINATION OF THE MISALIGNMENT

M. Domínguez [a], B. Arias [a]

[a] Dept. of Cartographic, Geodesic Engineering and Photogrammetry, Leon University, Astorga Avenue, Ponferrada, Spain – maria.dominguez@unileon.es, benjamin.arias@unileon.es

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ABSTRACT:

The Agricultural Technological Institute of Castilla y León (ITACYL, Spain) is developing the so called Spanish National Orthophoto Program (PNOA) inside its regional boundaries, based on aerial images with 0.25 m and 0.50 m GSDs obtained with large format digital cameras. The flights are conducted with the usual set of sensors: camera, INS and GPS. In order to obtain the misalignment of inertial system over the calibration test field built in Valladolid by ITACYL, flights have been necessary. First, the procedure established by Arias (EuroCOW 2008) was carried out to prevent the variation of PPA in the camera affecting the determination of the misalignment. The aim with calibration flight is, firstly, to determine the misalignment, and then, to contrast the focal length and principal point position. After having calculated the misalignment, their influence on the flight PNOA de Castilla y León was analized, particularly in the area centered in Ponferrada Campus of the University of Leon. To check the quality of misalignment obtained, the high density of points taken in this area were used. The software used in the automatic measurements of tie points is Match-AT v.5.2 from Inpho, while the computation of the Aerotriangulation with different parameters has been done with Bingo v.5.6.

1. INTRODUCTION

The images from several large format digital cameras were obtained by processing several single sub images, each of them attached to physical CCDs. To attain this target, the camera and its different elements were carefully calibrated in a laboratory. Nevertheless, flying conditions are not the same as laboratory conditions and so, some residual errors in image observations arise.

In the Congress of the EuroCOW held in 2006, Barcelona, some of the papers dealt with this issue while trying to harness the use of additional parameters to render the behaviour of the images from the Vexcel UltraCamD and Z/I DMC. While some authors proposed to apply the so called Ebner parameters for the DMC, either for the whole image (Honkavaara et al, 2006a) or instead for the different zones of this same camera (Kornus, 2006), some other authors used specific sets of additional parameters for the DMC and for the UltracamD (Gruber et al, 2006; Kruck, 2006). Some other contributions after this Congress continued in the same direction (Honkavaara et al, 2006b, 2006c; Alamús, 2006).

In the Congress of Hannover, in 2007 some more papers regarding the use of additional parameters for the UltraCamD and the DMC were presented (Alamús et al, 2007; Baz et al, 2007; Jacobsen, 2007; Spreckel et al, 2007).

In the Photogrammetric Week of the year 2007, a contribution was presented which applied the additional parameters on the new camera UltraCamX (Gruber, 2007) while some new strategies for the DMC appeared, such as the consideration of a correction grid in the generation of the virtual image or the use of four grids derived by a collocation technique (Dörstel, 2007).

Finally our work was presented in the EuroCOW 2008 congress (Arias et al, 2008), using a calculation methodology to obtain the misalignment, which includes a flight plan and check of the internal geometry of the camera.

The later sections detail the methodology and its application.

2. MATERIALS AND METHODS

2.1 Flights

This study uses a calibration flight which has been performed with GSD of 0.10 m. A total amount of 20 control points were presignalized and observed. The shape of the strips is depicted in figure 1.

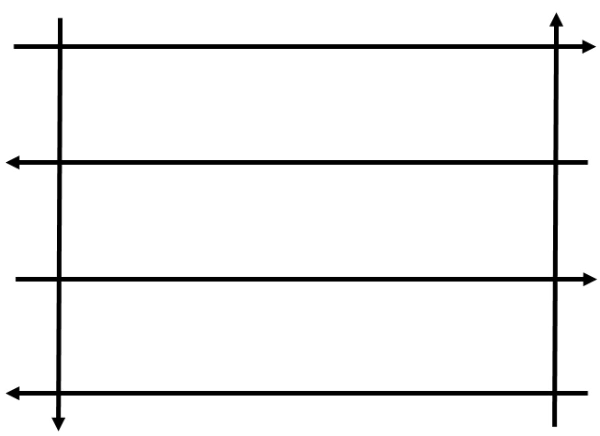

Figure 1. Configuration of strips of calibration flight.

Making use of the flight PNOA with GSD of 0,25 m. to check the quality of determining the misalignment

2.2 Measures

The control points were measured with GPS equipment ALTUS model APS3. The photogrammetrics measures were performed with Match-AT v.5.2.

2.3 Computation

The computation of the Aerotriangulation has been done with Bingo v.5.6.

It follows the methodology described in 2008 (Arias et al, 2008) based on a flight formed by longitudinal and transverse strips:

Step 1.- Not to compute either projection centers nor attitude: this will determine whether there is a previous problem. If no problem appears, in principle there is no problem with the photocoordinates and we can continue with the calibration of the system. If a problem is detected here, it makes no sense to continue, and the first measurements must be repeated, and then the calculation. If the problem persists, it is recommended to repeat the calibration flight.

Step 2.- To calculate with projection centers and not attitude: this will determine if here is a major shift and drift. In case that one of these two components is very large, it is recommended to repeat the calculation of trajectory, with post-processing GPS included (even if there are breaks observing cycle, or loss of ambiguities).

Step 3.- To calculate with projection centers and attitude: To determine finally the misalignment, with the assurance that the coordinates and projection centers are correct.

Step 4.- Repeat the previous calculation, but without control points to avoid any systematic tendence produced in these points.

2.4 Note on Principal Point

While Match-AT v.5.2 uses Principal Point of Autocollimation (PPA), BINGO v.5.6 uses Principal Point of Symmetry (PPS). Therefore, when measuring points in Match-AT, the PPA for the coordinates image is then considered.

Thus, BINGO, which works on PPS, calculates the position of PPA to calibrate, and this should result in a PPA with coordinates x=0 and y=0 if the camera works well.

3. RESULTS AND DISCUSSION

3.1 Boresight Misalignment

Apply the methodology proposed, distinguishing two flight calibration settings:

- Config. A: all strips, four E-W and two N-S.
- Config. B: only strips E-W.

3.1.1. Results of Step 1: With BINGO, coordinates are calculated Principal Point of Symmetry. Although not an ideal configuration, having no increase in height in the test field or making a flight up to double-height, in the results presented in 2008 we can see that for large format digital cameras a single flight can be used, always obtaining a constant focal length while Principal Point of Symmetry variable is shown. The results are shown in Table 1.

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Config	*xH*	*yH*	σ_0
A	0.0144	-0.0394	1.10
B	0.0043	0.0112	1.09

Table 1. Results of the computation of the position of the principal point for the A, B configurations, where: xH, yH: coordinates of the principal point; σ_0; sigma naught of the bundle adjustment.

3.1.2. Results of Step 2: The structure of the flight cancels the effects of the drift, and so this has no bearing on the determination of the misalignment.

3.1.3. Results of Step 3: We present the results of misalignment.

Config	$d\omega$	$d\varphi$	$d\kappa$	σ_0
A	0.1396	-0.0802	-0.1869	1.47
B	-0.1407	-0.0811	-0.1867	1.46

Table 2. Results of the computation of the misalignment for the A, B configurations, where $d\omega$, $d\varphi$, $d\kappa$: misalignment,: σ_0:sigma naught of the bundle adjustment.

As you can see, there are virtually no differences between the two configurations.

3.1.4. Results of Step 4: Finally, the results of the calculated misalignment without the support points are shown in Table 3.

Config	$d\omega$	$d\varphi$	$d\kappa$	σ_0
A	-0.1388	-0.0802	-0.1871	1.47
B	-0.1401	-0.0811	-0.1868	1.47

Table 3. Results of the computation of the misalignment for the A, B configurations, where $d\omega$, $d\varphi$, $d\kappa$: misalignment,: σ_0:sigma naught of the bundle adjustment.

As you can see, these are similar to those obtained in the previous step.

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