Universität Stuttgart
Germany

Institut für Photogrammetrie

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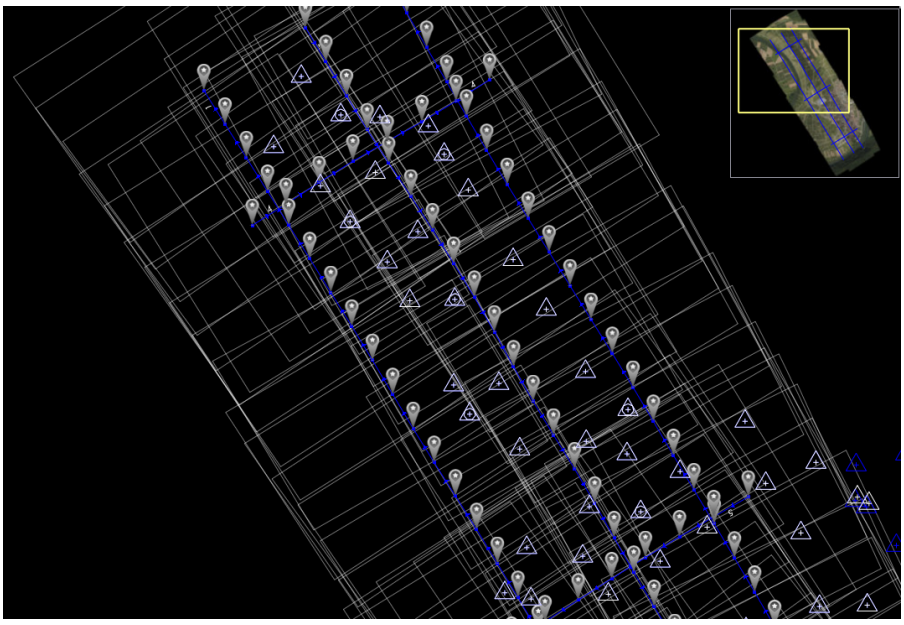
Geomatics Engineering GeoEngine
Airborne Data Acquisition

Lab 1: Image Orientation – Spatial Resection (Summer 2019)

Deadline: **Wednesday, May 29, 2019**

The orientation of images is the essential step within the photogrammetric data processing chain. Typically such step is not done within a single image procedure (like spatial resection) but all images forming the image block are considered simultaneously. This so-called aerial triangulation typically often is solved via bundle adjustment, i.e. the image observations are directly related to their corresponding object points via collinearity equations. Additional observations like GNSS or GNSS/inertial direct exterior orientation measurements or additional parameters for the self-calibration of the camera system can also be considered within this step. These topics will be (partially) analysed in the following. We will start with spatial resection within this first lab, later followed by the bundle adjustment.

Each group (2 students per group) will process their own photogrammetric sub-block, formed from a sub-set of 2x5 images flown in the Hessigheim test site. Data was taken by a Gyrocopter platform using a digital mid format camera with 50 MPix (DigiCAM 50 with 50mm lens) and a nominal GSD of around 5-8cm (because of terrain variations) and 80/60 image overlaps. The overall block geometry of the whole image flight is depicted below, only smaller subsets will considered within the lab:



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USt-ID/VAT-ID: DE14779196

All data (and additional guidelines) are available from the CIP-Pool directory **\users\uebungen\AirborneDataAcquisition\Lab-AerialTriangulation** .

Working groups

The students groups (2 students per group) will deal with the following individual photo IDs:

Group	Images	Students
1	250-246, 197-201	Bingqing Xu, Yi Wei
2	248-244, 199-203	Yimeng Chen, Yi Wang, Xiaou Tan
3	246-242, 201-205	Ruwei Nie, Meijie Xiang
4	244-240, 203-207	Yifei Zheng, Ariane Miseke
5	242-238, 205-209	Zhenqiao Wang, Tianqi Xiao
6	197-201, 184-180	Thomas Daud Gisiri, Casimir Naangmenkuu
7	199-203, 182-178	Huang Yu, Pascal Kößler
8	201-205, 180-176	
9	203-207, 178-174	
10	205-209, 176-172	
11	250-246, 184-180	
12	248-244, 182-178	
13	246-242, 180-176	
14	244-240, 178-174	
15	242-238, 176-172	

Lab 1 – Project set-up & spatial resection

The first step in AT (after project definition) is the observation of image coordinates. This consists of the manual measurement of control points followed by the automatic measurement of tie points. Before the measurements are done, the relation between pixel and image coordinates (interior orientation) has to be defined, which is fixed for digital cameras.

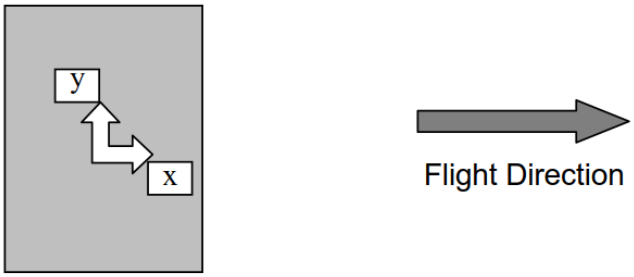
The spatial resection allows for the exterior orientation of one single image only. Even though it is not really used in operational practice it should be done as the first step here.

Action & Questions: Block set-up / interior orientation

- Perform the necessary steps for block set-up in the inpho ApplicationsMaster software as described in the manual.
- How is the interior orientation (i.e. here this relates the pixel to the image coordinates) defined for the DigiCAM camera? Discuss/explain the entries in the *`project_name.prj`* file (also discussed in class)!

Camera parameters are provided from a priori calibration run (see below)

Parameter	***Value***	
Pixel Size [µm^2]	6.0 x 6.0	
Image Size [Pixel]	8176 x 6132	
Focal Length [mm]	50.384	
Principle Point [mm]	x: -0.082	y: 0.195
Radial Distortion	Image Radius [mm]	Radial Displacement [µm]
	0 5 10 15 20 25 30 35	0 -1.8 -2.5 -2.6 -2.0 -0.7 1.1 3.2



Action & Questions: Spatial resection

The exterior orientation parameters have to be solved for **one** individual image (just select **one image from your 10 image sub-block, select that image, which contains the maximum number and optimal distribution of GCPs**), using the spatial resection. Please follow the given short manual for the practical steps. Please compare the following 3 versions for the resection:

1. 4 optimally distributed control points,
2. using 4 GCPs but located in almost the same image part,
3. all available GCPs in image.

The following results have to be documented within this lab report (for each version). It is not possible to save the results, so you have to create screenshots as explained in the manual.

- How many control points (max.) are available for your image? What is the resulting max. redundancy? What is the redundancy for the 4 GCP case?
- Visualize the residuals / estimated errors of each GCP version. Explain & discuss.
- Analyse the variations of estimated EO parameters for each GCP version. Version 3 may serve as reference case. Variations have to be discussed! Carefully analyse the residuals. Again this has to be done for each version.
- Analyse the estimated precision of EO parameter for each GCP version.
- Explain briefly the structure of the computed correlation-matrix. Especially discuss, why some of the unknowns are highly correlated!

Within your report please describe all your processing steps. ***Only one PDF report for each group is requested here****!*
Submit reports in digital form only. Please upload to the ***ILIAS directly****.*
Please use the following ***naming convention****: ADA-Lab1-Grp#-LastName1-LastName2.pdf (# has to be exchanged by group number).*