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Exercises in photogrammetry using PhoX

Module 7: Space resection

Objectives:

-   Orientation of a single image
-   Measurement of control points
-   Calculation of space resection and direct linear transform (DLT)
-   Effect of measurement errors to the result
-   Effect of number and distribution of tie points
-   Comparison of orientation parameters from different approaches
-   Camera calibration by additional parameters

Task 1: Measurement of control points and calculation of exterior orientation

Description:

For the purpose of photogrammetric building reconstruction of the historical orphonage in Varel
(Germany) a total number of about 650 images have been acquired with a digital camera Nikon D2X,
f=24mm. Control points have been targeted at the building façade and measured by a total station. As
examples, two images shall be oriented by means of space resection.

Processing steps:

-   Load the images "DSC_0196.jpg" and "DSC_0198.jpg" and the camera file "111.cam".
-   Import the control point file "Waisenstift.obc" (*Project→Import→Object elements – AICON format*).
-   Measure the image coordinates of control points (*Measure→Image coordinates*). The position of
    control points is displayed in image "PP_overview.jpg".
-   Open the window for space resection (*Orientation→Space resection*). Select suitable image and
    control points and calculate the exterior orientation by space resection and by DLT. Analyse the
    results (output file "resection.txt").
-   Save your project (*Project→Save project as* ...).

Test questions:

1.   Mathematical model of space resection and DLT   ....
2.   Achieved precision of exterior orientation   ....
3.   Parameters of exterior orientation   ....
4.   Physical units of results   ....
5.   Minimum number of control points for space resection ....
6.   Minimum number of control points for DLT   ....
7.   How can initial values be generated?   ....

Task 2: Extended experiments

-   Compare the parameters of exterior orientation resulting from space resection with those from a
    bundle adjustment (file "Waisenstift.eor"). How can the deviations be explained?
-   Vary the number and position of control points and compare the resulting orientation parameters.
-   Execute space resection with simultaneous calculation of the parameters of interior orientation and
    compare the results with given calibration data from the camera file. Note that the output file
    "resection.txt" will be overwritten after each calculation.