Regular Digital Camera as a Practical Geodetic Measurement Tool: Issues and Challenges

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Digital photography field is undergoing major technology progress

- Qualitative D. Cameras become not expensive.
- High resolution between 5 to 20 MegaPixel as a normal.
- High qualitative optics.
- Smartphones with qualitative D.cameras.

Canon EOS600D
18 MegaPixel
$ 550

Canon EOS1000D
10 MegaPixel
$ 350

iPhone 5 Galaxy S3
8 MegaPixel
D.Camera

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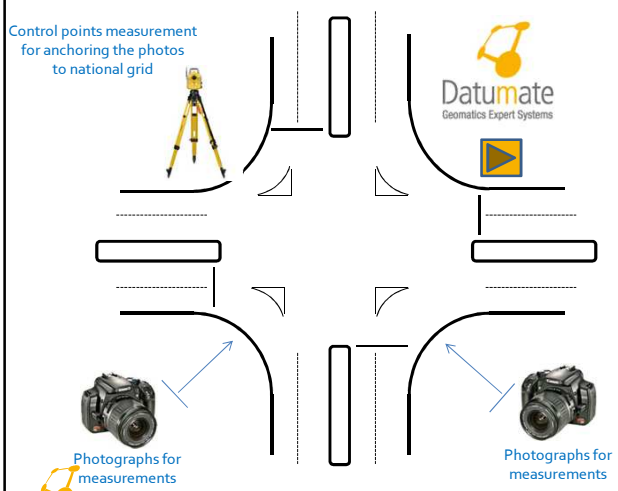
Close range ground photogrammetry: implementation basics



In the field:

- Taking overlapping photos of the project from different angles.
- Measuring control points appearing in the photos.

In the office:

- Building photo model using homological tie points.
- Anchoring the model to the national grid.
- Measuring new points (3D coordinates)

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Main challenges of using D.Camera as geodetic instrument for measurements

1. Camera calibration process
2. The process of linking the images together in one cluster for building the 3D photogrammetric model.
3. New point measuring process.

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Digital camera calibration challenge

Three calibration methods are known:

1. Field method
2. Rod method with control points.
3. Chessboard method

Calibration parameters:

1)Radical distortion parameters (K_1, K_2)

2)Central point coordinates of the camera sensor. (X_0, Y_0)

3)The focal point distance of camera lens from the sensor (f)

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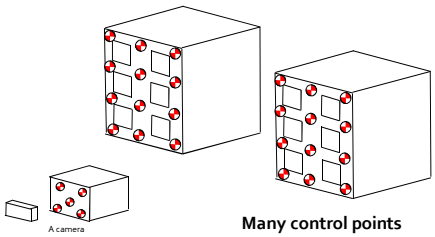
Field calibration method

Advantages:

- Accurate
- Once it built, it could be used for long time.

Drawbacks;

- Difficulties in finding appropriate place.
- Must preserve it for long time.



Many control points located on building face

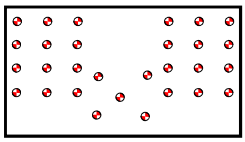


Photo of the field targets

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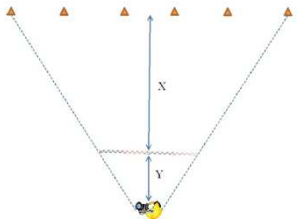
Rod calibration method

Advantages:

- On the job high accurate method
- Feasible for surveyors using surveyors daily tools.

Drawbacks;

- Long procedure in the field: 1 hour
- Long procedure in the office.



Rod calibration filed scheme

True photos of the Rod and the control points

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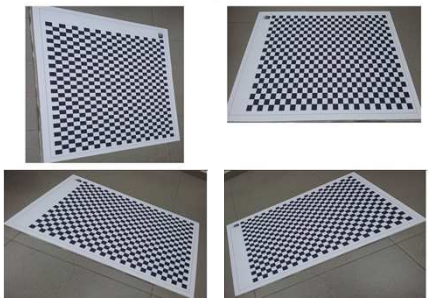
Chessboard calibration method

Advantages:

- Feasible
- Very easy to use especially: if automatic point detection of chessboard corners is existed

Drawbacks;

- Doubt whereas the field is a plane.
- Challenge with large focal point length.



True photos of chessboard target in the office

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Comparing between Chessboard and Rod method

- 3 experimentations for more than 200 points.
- Focal length = 18 mm
- In Relative to the distance between new points and D.Camera:
- **The smaller the focal length of the lens the use of chessboard will be very similar to Rod method quality.**

Distance of Objects from Camera [m]	DY [m]	DX [m]	DH [m]
10	0.007	-0.001	0.002
20	-0.002	-0.006	0.003
30	0.017	0.013	0.001
40	0.025	0.023	0.000
50	-0.027	-0.036	0.003
60	-0.056	-0.074	0.003

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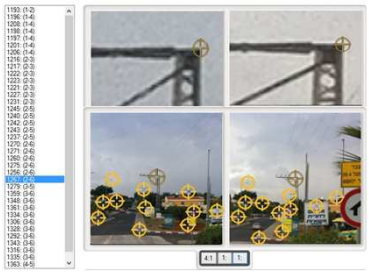
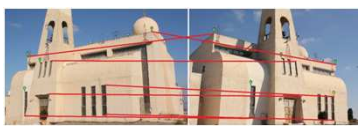
Linking images challenge

- Manual linkage: 4 control points for each image.
- Automatic linkage: using auto-find homological tie points.





Anchoring using homological tie points

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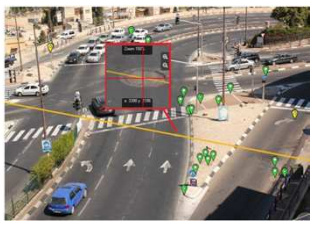
Measuring new points challenge:

- Manual measurement: each new points must be digitized manually at least in two different images.
- Automatic measurements: automatic detection of the digitized new points in the other images using image processing algorithms.

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Real Projects

Buildings


Streets


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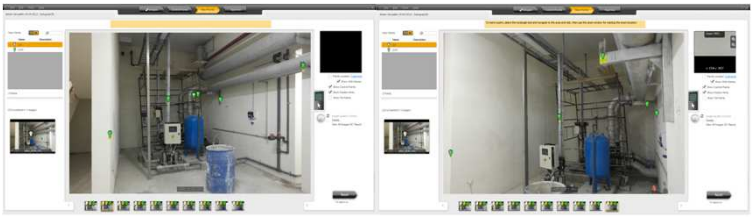
Real Projects

Pipelines



Regular topography

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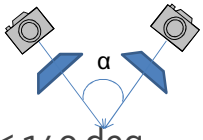
Accuracy results

- Comparing D.Camera **(Canon 600D with 18 mm focal length lens)** works measurements using Datugram 3D software with TPS measurements:
  - **1-2.5 cm in position till 150 meters.**
  - **3 – 15 mm in heights till 150 meters.**
- Angle α between images >50 deg. and < 140 deg.



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Digital camera advantages for geomatics:

- Geodetic level accuracy.
- Saving time → Increasing in field staffs production.
- No need for returning back to the field when detecting dis-missed object's points.
- Measurements by D.Camera could be done by CAD drawer and isn't necessary by land surveyors.
- Perfect documentation of the executed measurements.
- Unprecedented ability of quality control

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Next revolution is coming

Thank you…

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