

# CAMERA CALIBRATION REPORT

**Nikon D810, 135 mm**

**Back snr. 6037660**

**Lens snr. 51520588**

Calibration date: 2017-11-19

Calibration ID: YC030054\_2017-02

Oslo, 2017-12-01

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Process owner, Aerial triangulation

**terratec** 

## Summary

The calibration was made as an integral part of project "ProRail 2017-10".  
Boresight misalignment was estimated as part of the works.

## Input material

| Flight                                                                     | No. of flight lines | No. of images | No. of GCPs | Image overlap        |
|----------------------------------------------------------------------------|---------------------|---------------|-------------|----------------------|
| 40869 Calibration field Arnhem, *<br>GSD 1.0 cm**. Flight date: 2017-11-04 | 4 + 3 cross lines   | 416           | 12          | fwd. 55<br>side 60 % |

\*) See calibration field layout page 4

\*\* ) At image center

## Methodology

### Software

- Image measurements / block adjustment / estimation of camera calibration parameters: Match-AT and inBlock ver. 8.0.6 (Inpho)

### Estimation of physical parameters

Focal length, principal point (PPA) and lens distortion (3 parameters radial distortion) was estimated using aerial triangulation (AT) and subsequent block adjustment with GNSS/IMU support.

### Estimation of boresight misalignment

Boresight misalignment was estimated after application of the calibration.

## Result

### Physical parameters

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Symbol               | Value                                           | Std. dev.                          | Unit   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------|------------------------------------|--------|
| Image size                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -                    | 7360 x 4912                                     | -                                  | pixels |
| Image resolution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                    | 4.9                                             |                                    | μm     |
| Calibrated focal length                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | f                    | 131.689                                         | 2.2                                | mm/μm  |
| Calibrated PPA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Xp<br>Yp             | -0.041<br>0.029                                 | 5.0<br>4.1                         | mm/μm  |
| Calibrated radial distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | K0<br>K1<br>K2<br>K3 | 0<br>-1.31134e-05<br>4.24584e-09<br>9.66142e-12 | -<br>2.6e-07<br>1.3e-09<br>1.9e-12 | -      |
| Calibrated decentering distortion                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                    | -                                               | -                                  | -      |
| correction for radial distortion<br>$DX = X * (K_0 + K_1 * R^2 + K_2 * R^4 + K_3 * R^6 + K_4 * R^8 + K_5 * R^{10} + K_6 * R^{12} + K_7 * R^{14})$ $DY = Y * (K_0 + K_1 * R^2 + K_2 * R^4 + K_3 * R^6 + K_4 * R^8 + K_5 * R^{10} + K_6 * R^{12} + K_7 * R^{14})$ correction for decentering distortion<br>$DX = P_1 * (R^2 + 2 * X^2) + 2 * P_2 * X * Y$ $DY = 2 * P_1 * X * Y + P_2 * (R^2 + 2 * Y^2)$ with $R = (X * X + Y * Y)^{1/2}$<br>X and Y are with respect to principal point (PPA=PPS) |                      |                                                 |                                    |        |

### Boresight misalignment

| Parameter              | Omega  | Phi    | Kappa   |
|------------------------|--------|--------|---------|
| Applied correction (°) | 0.0540 | 0.1020 | -0.1645 |

## Notes on usage of the calibration

### Parameter values:

- The tabulated lens parameters are distortion values. The signs of the parameter must be adapted to the actual software (e.g. Inpho software expects input of correction values and consequently requires opposite sign of lens distortion parameters)

## Calibration field layout

