



Calibration Certificate

N^o 02109383

Object Digital Aerial Survey Camera

Manufacturer Z/I Imaging D-73431 Aalen

Type DMC Panchromatic

Serial Number 02109383

Customer

Calibration performed at:

Deutscher Kalibrierdienst (DKD)

Kalibrierstelle für Meßgrößen der geometrischen Optik

at Carl Zeiss, Oberkochen

(DKD Registration No. : DKD-K-0502)

Number of pages of the certificate 3

Date of Calibration 15.05.2003

Certified	Date	Z/I QS Manager	Calibration Performed
	15.05.2003	(M. Raubach)	(J.Hefele)

Cameratype: DMC
 Lenses mounted: Pan f=120 mm

Serial no.: 02109383

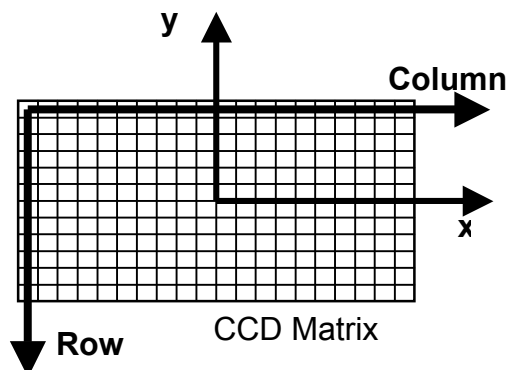
Calibration Parameters:

Calibrated Australis Parameters
 Camera ID : 02109383

	Param	Adjusted	Std.dev.	
Principal Point [mm]	dxp	1.437e-004	2.878e-006	is significant
	dyp	-1.521e-004	5.629e-006	is significant
Focal Length [mm]	dc	-4.050e-004	3.448e-006	is significant
Radial Distortion	K1	7.147e-001	8.471e-002	is significant
	K2	-4.542e+002	7.557e+001	is significant
	K3	2.147e+004	1.969e+004	not significant
Decentering Distortion	P1	0.000e+000	1.000e-031	is eliminated
	P2	0.000e+000	1.000e-031	is eliminated
In Plane Distortion	b1	9.298e-005	2.386e-005	is significant
	b2	1.593e-005	1.141e-005	not significant

Adjusted Focal length = 120.0 + dc = 119.99959 [mm]

Definition of coordinate system:



Distortion Model:

$$\begin{bmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{bmatrix} = \begin{bmatrix} x - x_0 \\ y - y_0 \\ -f \end{bmatrix} \quad r = \sqrt{\bar{x}^2 + \bar{y}^2}$$

$$\Delta x = \Delta x_0 - \frac{\bar{x}}{\bar{z}} \Delta f + \bar{x}(r^2 K_1 + r^4 K_2 + r^6 K_3) + (r^2 + 2\bar{x}^2)P_1 + 2\bar{x}\bar{y}P_2 + \bar{x}B_1 + \bar{y}B_2$$

$$\Delta y = \Delta y_0 - \frac{\bar{y}}{\bar{z}} \Delta f + \bar{y}(r^2 K_1 + r^4 K_2 + r^6 K_3) + 2\bar{x}\bar{y}P_1 + (r^2 + 2\bar{y}^2)P_2$$

Note:

DMC Virtual Images get computed from 4 (pan) up to 8 (pan + multi spectral) cameras. During generation of virtual images (image mosaics) lens distortion gets completely eliminated. The resulting virtual image is a distortion free image rectified to a nominal focal length of 120 mm [Dörstel, Jacobsen, Stallmann, 2003; Zeitler, Dörstel, Jacobsen, 2002].

Camera calibration must not be applied during data compilation as the virtual images have nominal focal length, are distortion free and have no fiducial marks.

Camera Calibration Parameters listed referring to DMC intermediate images!

DMC geometric calibration is performed at the Carl Zeiss Calibration laboratory. The instruments used are calibrated items and being certified for camera calibration by *Deutscher Kalibrier Dienst* with permission of *Physikalisch-Technische Bundesanstalt*. The Brown Parameter Model (so called Australis Parameter) is used to model the camera geometry. The algorithms used to compute the Australis Parameters is developed by ifp (Stuttgart Institute for Photogrammetry) and published at [\[Dörstel et al. 2003\]](#). The resulting DMC image mosaics are corrected for all geometric influences.

Dörstel C., Jacobsen K., Stallmann D. (2003): DMC – Photogrammetric accuracy – Calibration aspects and Generation of synthetic DMC images, Eds. M. Baltsavias / A.Grün, Optical 3D Sensor Workshop, Zürich

Zeitler W., Dörstel C., Jacobsen K. (2002): Geometric calibration of the DMC: Method and Results, Proceedings ASPRS, Denver, USA.