19-1

Pbase

X_0
Y_0
f
K_1
K_2
K_3
P_1
P_2

compare with other calibration software

C_1K_1
C_2K_2
C_3K_3
C_1P_1
C_1P_2

other sources of calib. info.

- USGS
- photo modeler
- I witness
- openCV

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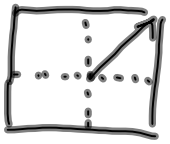
19-2

ncol, nrow

meas: c, r or l, s



$x = c - ncol/2$

$y = -(r - nrow/2)$

$maxr = \sqrt{(ncol/2)^2 + (nrow/2)^2}$

$C_1 = 1/maxr^2$

$C_2 = 1/maxr^4$

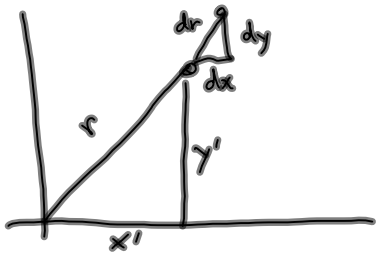
$C_3 = 1/maxr^6$

$x' = x - X_0$

$y' = y - Y_0$

collin.m

$r = \sqrt{(x')^2 + (y')^2}$



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$dr = k_1 r^3 + k_2 r^5 + k_3 r^7$ (radial)

$dx_d = P_1 (r^2 + 2(x')^2) + 2 P_2 x'y'$ text book

$dy_d = 2P_1 x'y' + P_2 (r^2 + 2(y')^2)$

$dr = c_1 k_1 r^3 + c_2 k_2 r^5 + c_3 k_3 r^7$ I use

$dx_d = c_1 P_1 (r^2 + 2(x')^2) + 2 c_1 P_2 x'y'$

$dy_d = 2 c_1 P_1 x'y' + c_1 P_2 (r^2 + 2(y')^2)$

$\frac{dx}{x'} = \frac{dr}{r}$ $dx_r = x' \frac{dr}{r}$

$\frac{dy}{y'} = \frac{dr}{r}$ $dy_r = y' \frac{dr}{r}$

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$\frac{dr}{r}$: $drr = c_1 k_1 r^2 + c_2 k_2 r^4 + c_3 k_3 r^6$

$dx_r = x' \cdot drr$

$dy_r = y' \cdot drr$

$x'' = x' + dx_r + dx_d$

$y'' = y' + dy_r + dy_d$

use in condition equations

$\begin{pmatrix} x - x_0 \\ y - y_0 \\ -f \end{pmatrix}$ x'' y''

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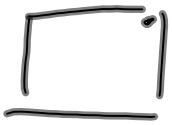
Canon XT

19-5

maxr = 2076.297



input C = 3300, r = 100

x = c - ncol/2 = 1572
y = -(r - nrow/2) = 1052
x' = 1601.33
y' = 1050.48
C_1 = 2.318 e-07
C_2 = 5.375 e-14
C_3 = 1.246 e-20

dr = .017535
dx_r = 28.080
dy_r = 18.420
dx_d = -0.122
dy_d = -0.664

numerical example of image coordinate refinement.

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x'' = x' + dx_r + dx_d = 1629.282
y'' = y' + dy_r + dy_d = 1068.237

X_0	-29.330
Y_0	1.159
f	4457.776
k_1	.028382796
k_2	-.018956408
k_3	.011558139
P_1	.16170141
P_2	-.580 11127

← calibration data for my Canon XT

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pixel 0.0064 mm

mean dist: $\sqrt{28^2+18.4^2} = 33.5$ pixels

$33.5 \text{ pix} \cdot .0064 \text{ mm/pix} = 0.214 \text{ mm}$

aerial camera dist: 2 μm

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