13-1

lens distortion model

$$\Delta x = \Delta x_r + \Delta x_d + \Delta \bar{x}_{m'} + \Delta x_f$$
$$\Delta y = \Delta y_r + \Delta y_d + \Delta y_{m'} + \Delta y_f$$

$\Delta \bar{x}_{m'}$: worst case

$$\Delta x_f = b_1 \bar{x} + b_2 \bar{y}$$
$$\Delta y_f = 0$$

b_1: scale difference

b_2: shear (non-orthogonality)

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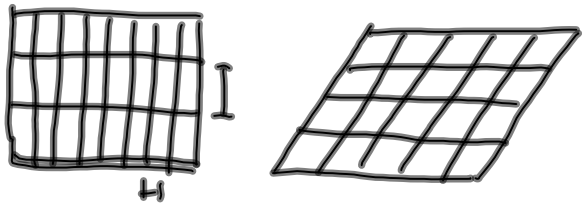
13-2



scale difference shear effect

radial, decentering, unflatness, in-plane

21 params:
- x_0, y_0, f
- k_1, k_2, k_3
- P_1, P_2
- $a_0 - a_{10}$
- b_1, b_2

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recall HW2 col.m

13-3

$P = [x; y; x_0; y_0; f; k_1; k_2; k_3; p_1; p_2;$
$b_1; b_2; \omega; \phi; \kappa; x_c; y_c; z_c; x; y; z]$

⋮

unpack p → names $x_0, y_0, \ldots$

$x_{sur} = x - x_0$
$y_{sur} = y - y_0$

$(\delta x, \delta y)_r, (\delta x, \delta y)_d, (\delta x, \delta y)_f$

$\delta x = \delta x_r + \delta x_d + \delta x_f$
$\delta y = \ldots$

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13-4

$F = [x - x_0 + \delta x + f * u/w;$
$y - y_0 + \delta y + f * v/w]$

could embed expanded col.m function in a loop to get partial derivatives for the inner orientation params

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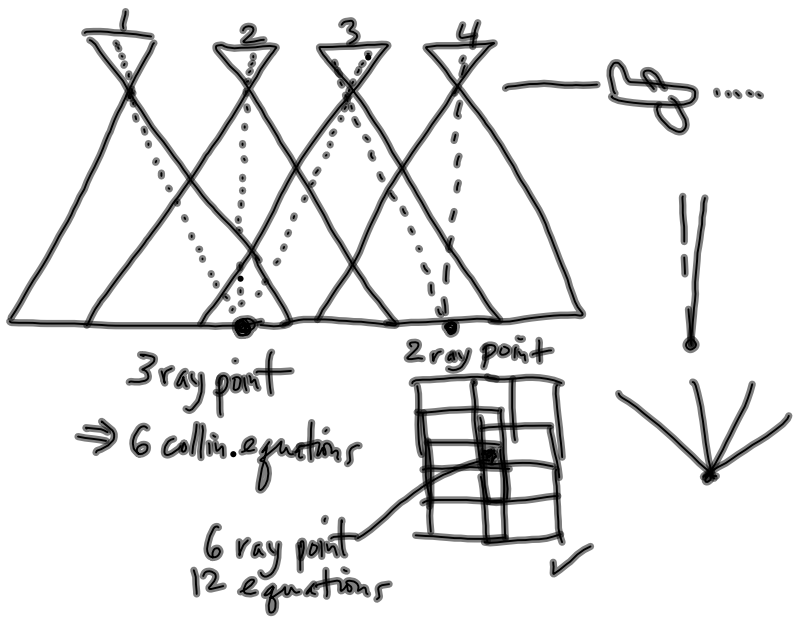
13-5



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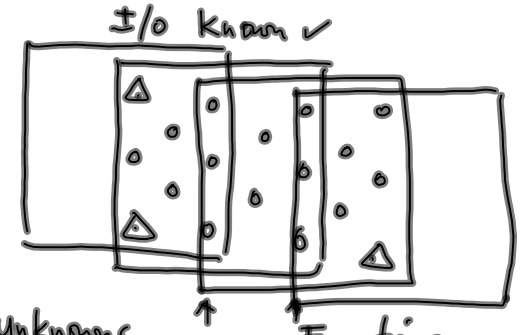
13-6



Unknowns

$4 \times 6 = 24$

$3 \times 15 = 45$

69

Equations

2Ray: $12 \times 4 = 48$

3Ray: $6 \times 6 = 36$

84

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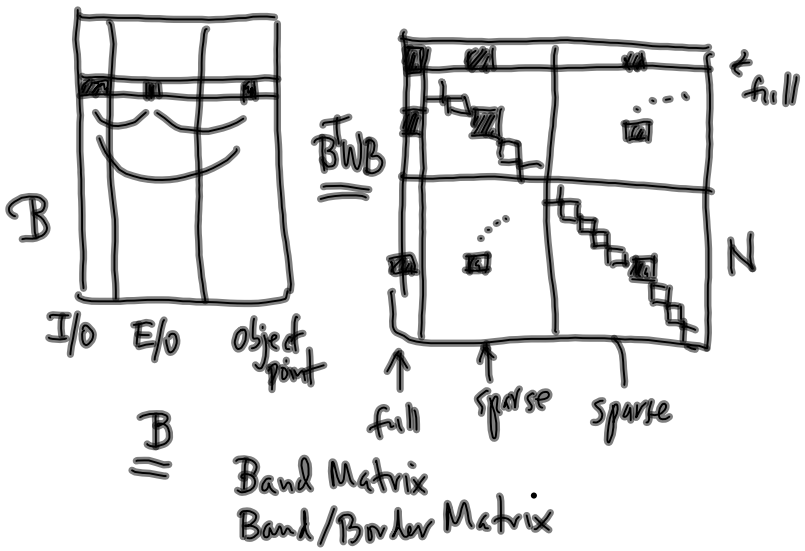
13-7



B = Band Matrix
Band/Border Matrix

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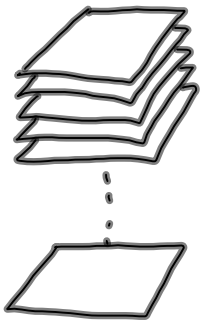
13-8

forming Normal Equations Sequentially

$$B^T W B = N \quad \left.\right\} \quad \delta = N^{-1} t$$
$$B^T W f = t \quad \left.\right\}$$

$$N_i = B_i^T W_i B_i \qquad N = \sum_{i=1}^{c} N_i$$
$$t_i = B_i^T W_i f_i \qquad t = \sum_{i=1}^{c} t_i$$



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13-9

photo adjustment (2 photos)

- BBA
  - 6+6
  - (12)
- R/O (5) ✓
- A/O (7) ✓

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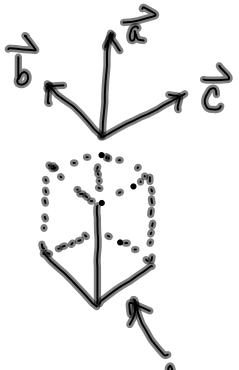
13-10

Relative Orientation



volume parallelepiped

$\vec{a} \cdot (\vec{b} \times \vec{c})$

triple scalar product

$$\vec{a} \cdot \begin{vmatrix} i & j & k \\ b_x & b_y & b_z \\ c_x & c_y & c_z \end{vmatrix} = \begin{vmatrix} a_x & a_y & a_z \\ b_x & b_y & b_z \\ c_x & c_y & c_z \end{vmatrix}$$

volume of solid

if volume = 0 then 3 vectors are coplanar

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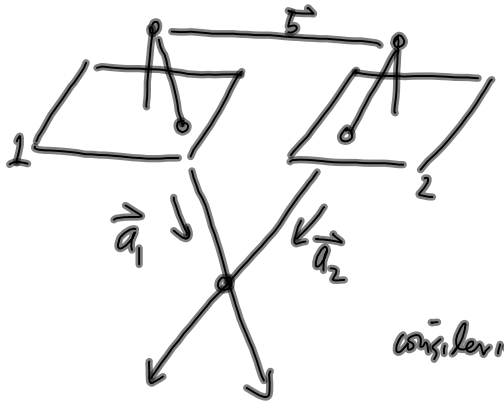

Fix orient photo 1

Parameters photo 2

6

walk, x, y, z

considering scale ambig.

13-11

require $\vec{b}, \vec{q}_1, \vec{q}_2$ be coplanar

T.S.P = ZERO

param's = 5

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