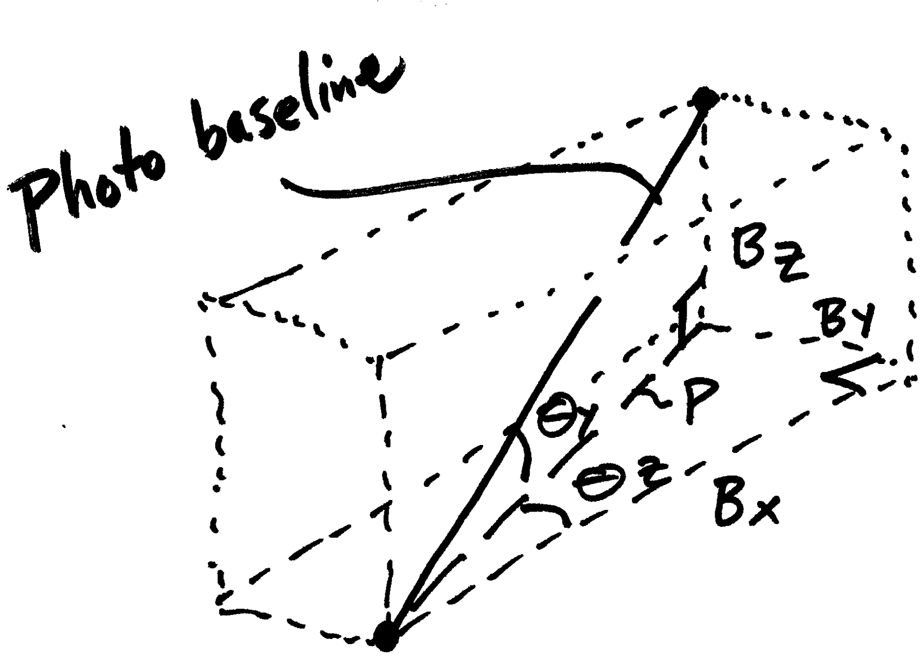
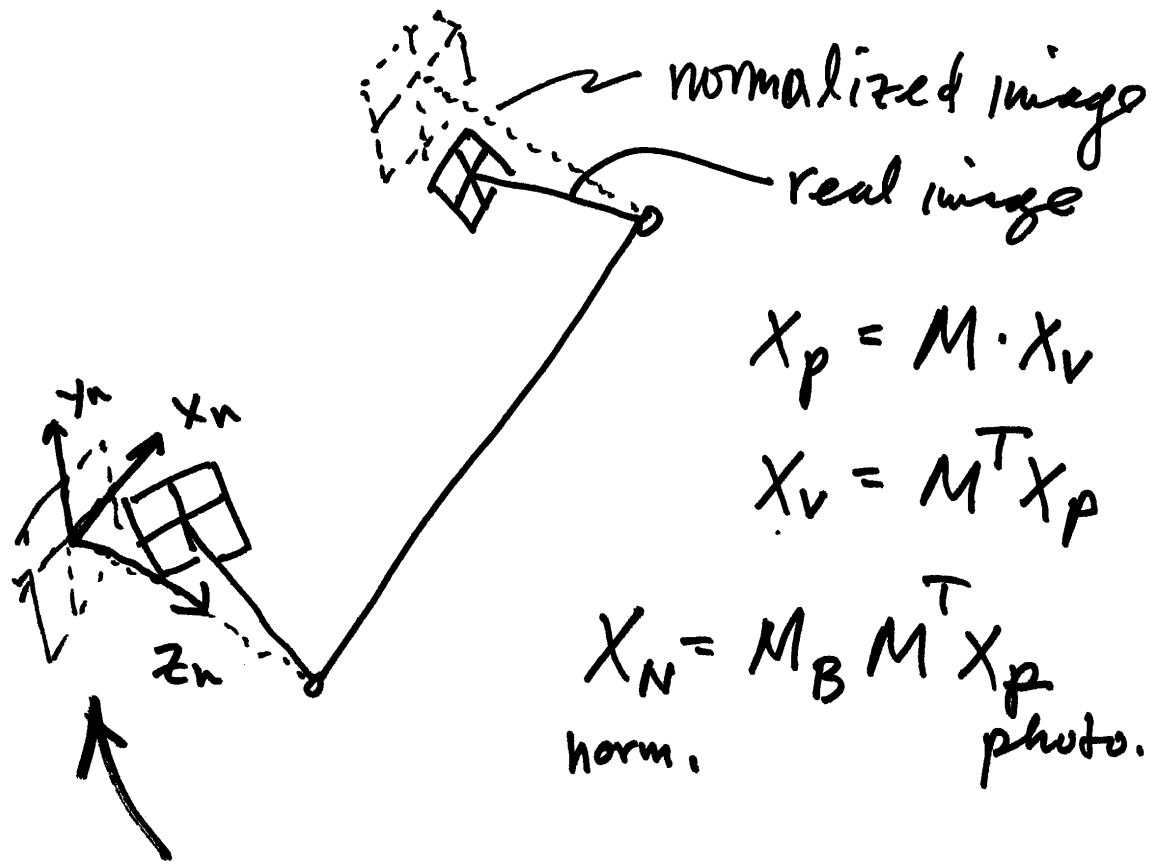
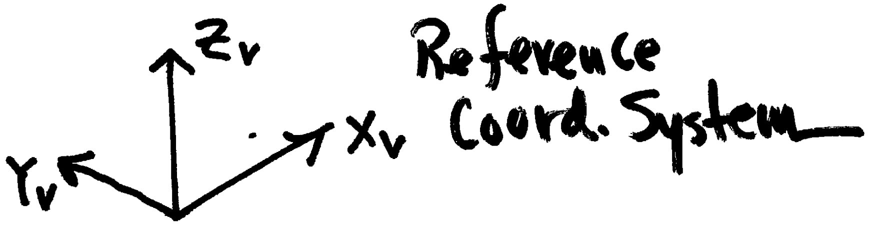




$$X_p = M \cdot X_v$$

$$X_v = M^T X_p$$

$$\underset{\text{norm.}}{X_N} = M_B M^T \underset{\text{photo.}}{X_p}$$



Normalized Coord. Sys.

- X_N parallel to base
- Z_N perpendicular to base (+ approx. parallel to actual photo optical axis)
- Y_N mutually orthogonal to be RHS

$$M_B = M_x(\Theta_x) \cdot M_y(\Theta_y) \cdot M_z(\Theta_z)$$

$$\underset{\text{norm.}}{X_N} = M_B \underset{\text{reference}}{X_v}$$

$$\begin{pmatrix} x_{n_1} \\ y_{n_1} \\ -f \end{pmatrix} : X_{N_1} = \underbrace{M_B M_1^T}_{M_{N_1}} X_{p_1} \cdot \begin{pmatrix} x_{p_1} \\ y_{p_1} \\ -f \end{pmatrix}$$

$$\begin{pmatrix} x_{n_2} \\ y_{n_2} \\ -f \end{pmatrix} : \underbrace{X_{N_2} = \underbrace{M_B M_2^T}_{M_{N_2}} X_{p_2}}_{\begin{pmatrix} u \\ v \\ w \end{pmatrix}} : \begin{pmatrix} x_{p_2} \\ y_{p_2} \\ -f \end{pmatrix}$$

$$x_{n_1} = -f \frac{u_1}{w_1} \qquad x_{n_2} = -f \frac{u_2}{w_2}$$

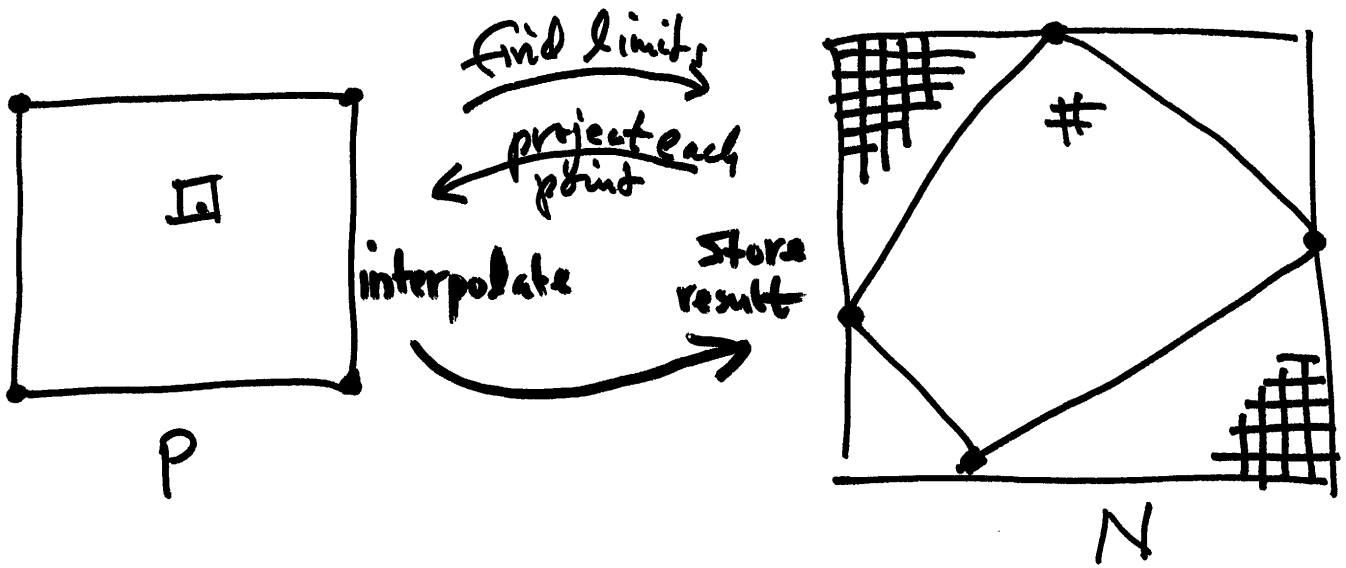
$$y_{n_1} = -f \frac{v_1}{w_1} \quad , \quad y_n = -f \frac{v_2}{w_2}$$

$$X_{N_1} = M_{N_1} \cdot X_{p_1}$$

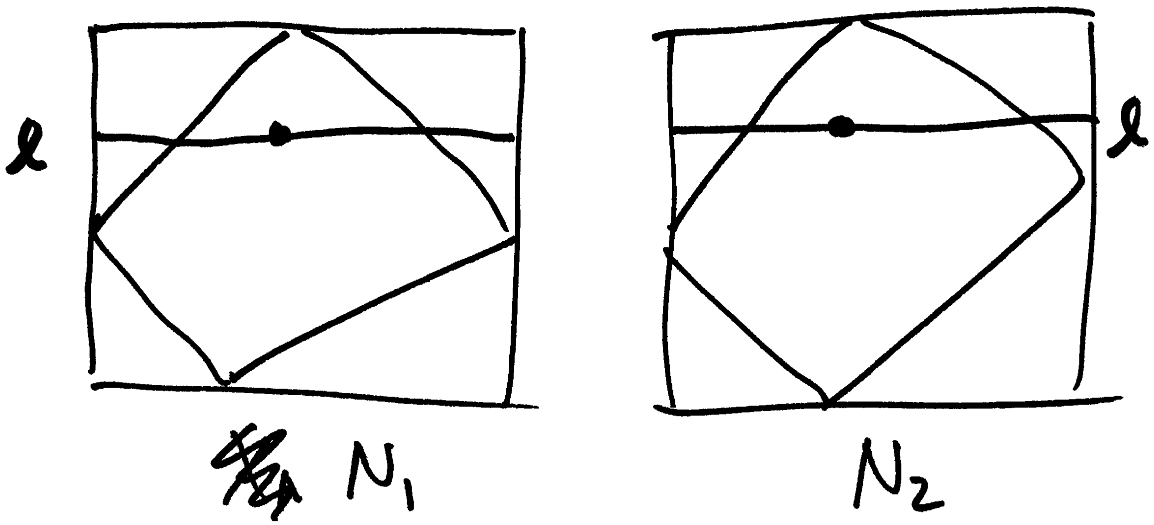
$$X_{N_2} = M_{N_2} \cdot X_{p_2}$$

$$X_{p_1} = M_{N_1}^T \cdot X_{N_1}$$

$$X_{p_2} = M_{N_2}^T \cdot X_{N_2}$$



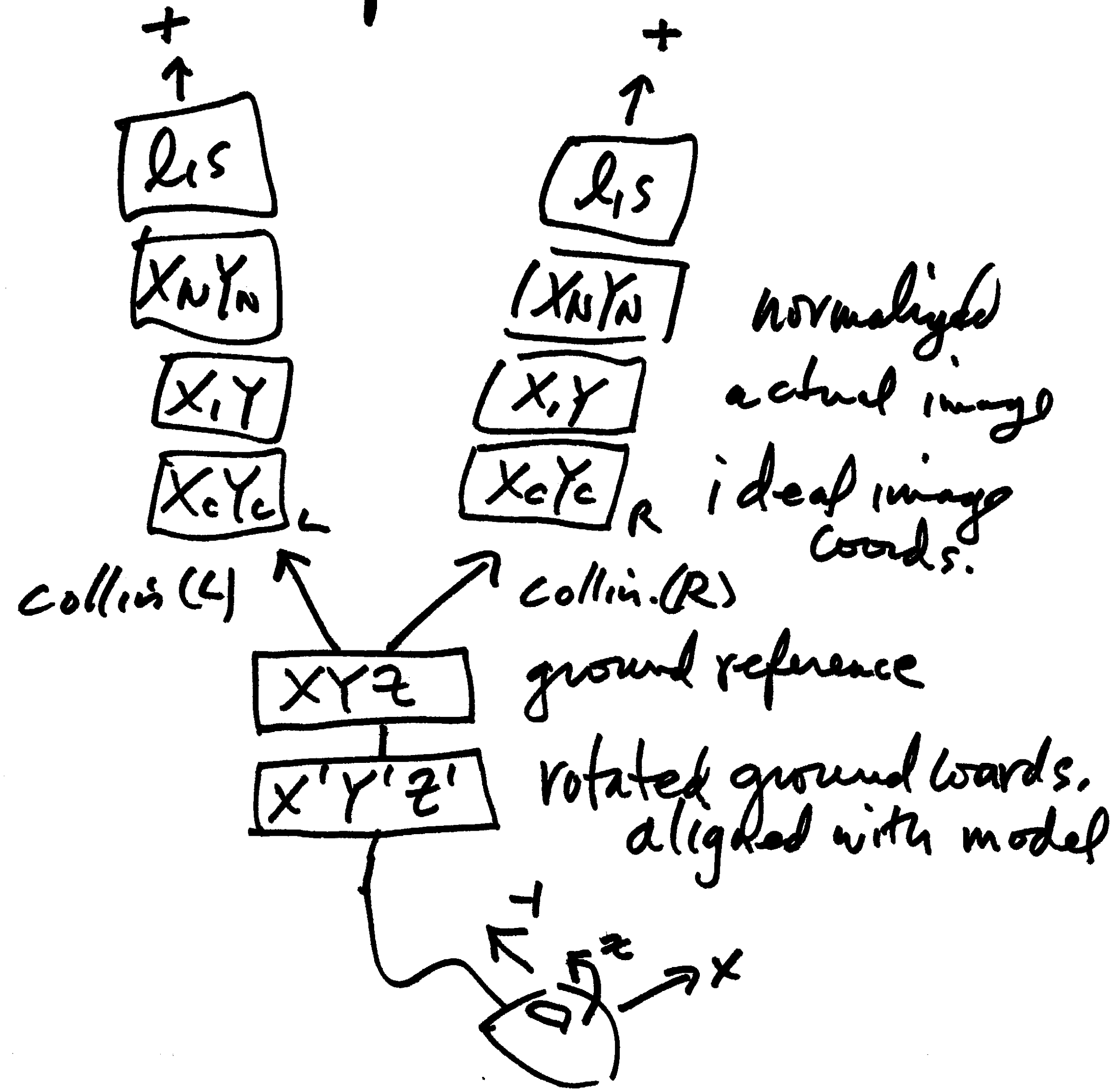
1. find limits, create empty file/array, selection of pixel size
2. step through N exhaustively
   - @ each pixel of N, transform N → P
   - interpolate intensity
   - store result in N I, RGB, ...

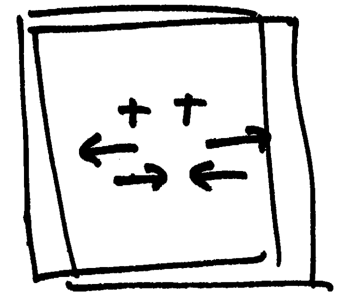


$N_1 \rightarrow$ Red channel
$N_2 \rightarrow$ Blue channel B+G
} anaglyph stereo

a point on line l in normalized image N_1, will also lie on line l in normalized image N_2

architecture of stereo workstation



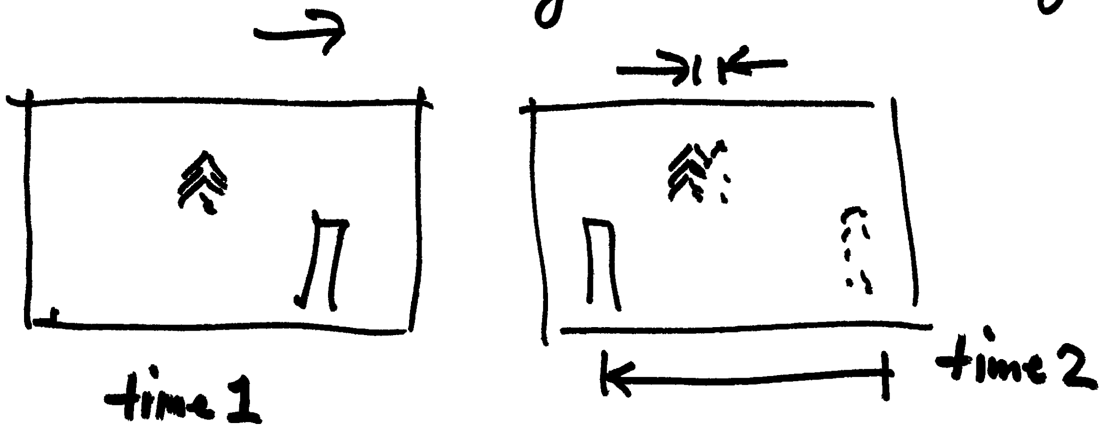


Z-motion from hand control causes "floating" mark to come together or move apart

hit button : record in data file
XYZ

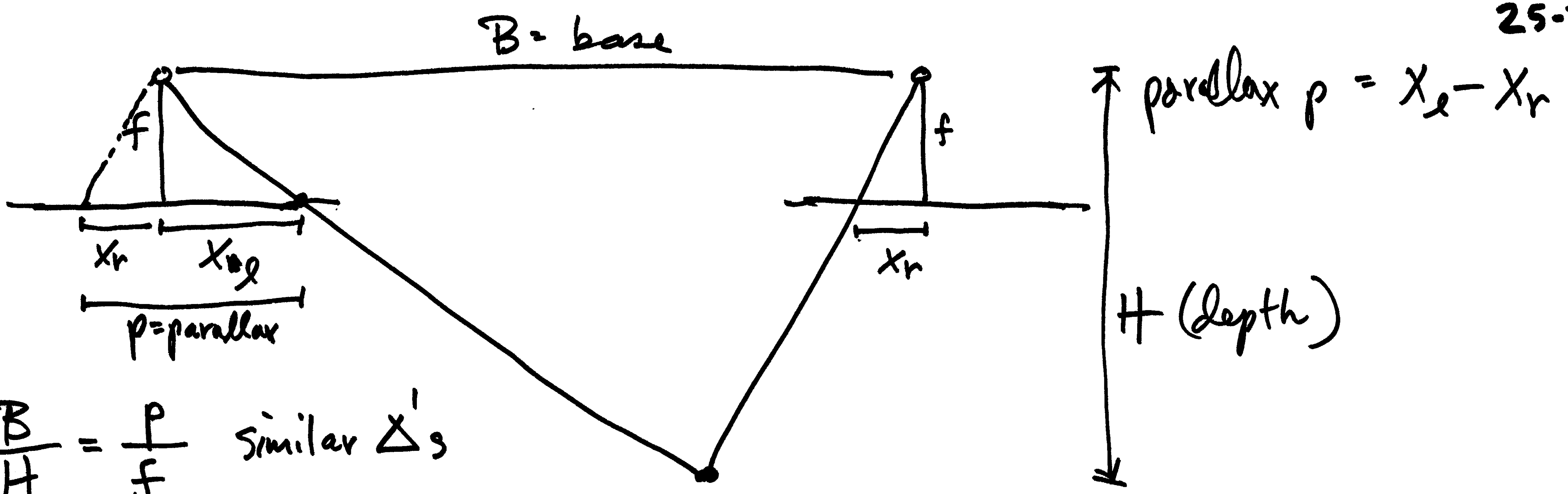
examples : BAE Socet Set
Z/I Image Station
Leica LPS

parallax: apparent displacement of an object caused by a change in location of viewer.



parallax (disparity) related to depth

objects viewed through window of moving vehicle
nearby fencepost has greater parallax than distant tree.



$$\frac{B}{H} = \frac{p}{f} \quad \text{similar } \Delta\text{'s}$$

$$\boxed{H = \frac{B}{p} \cdot f}$$

Far Away : small parallax

Near : large parallax

$$\frac{dp}{dH} \sim \text{scale}, \; B/H$$

$$p = \frac{B}{H} \cdot f, \quad \underline{\underline{\frac{dp}{dH}}} = -\frac{fB}{H^2} = -\left(\frac{f}{H}\right) \cdot \left(\frac{B}{H}\right)$$

$$= -\text{scale} \cdot B/H$$

$\frac{dp}{dH}$ gives the sensitivity of parallax with respect to depth or height

photos w/ B/H viewed by individual with eye base $= b$
<u>perceives</u> 3D model to lie at distance h (subjective)

if $B/H \approx b/h$, perceive scene as if looking with eyes

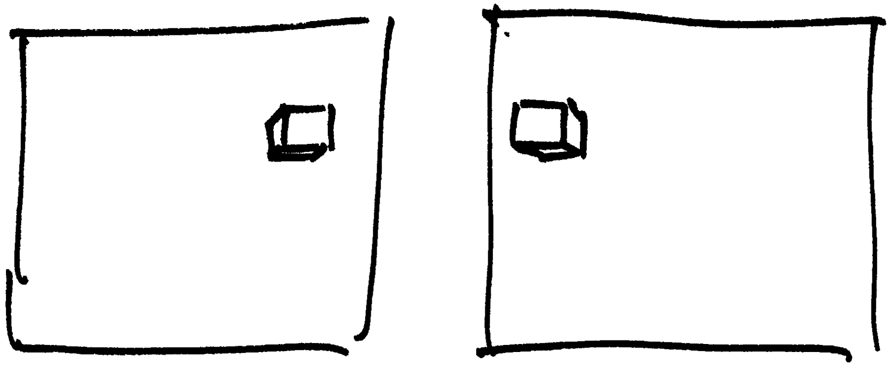
if $B/H > b/h$, perceive depth exaggeration

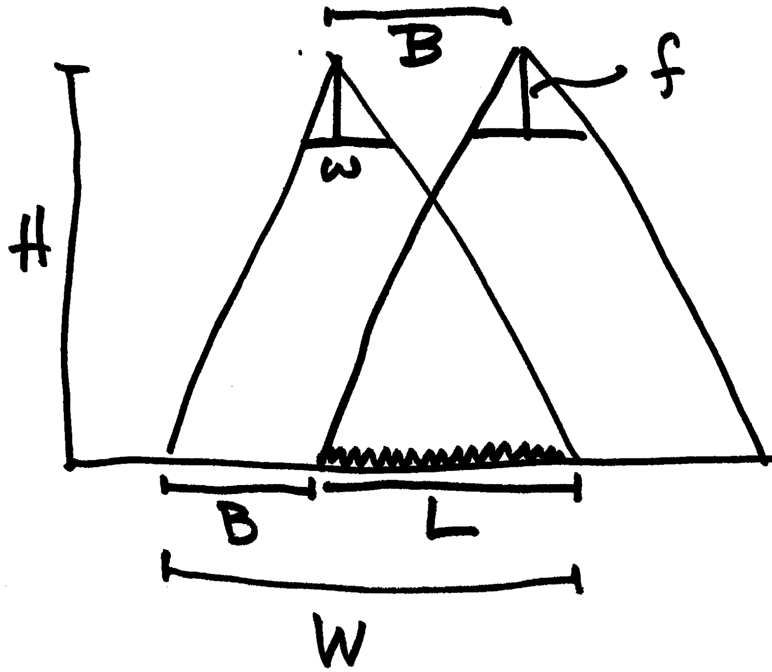
Vertical Exaggeration Factor: $\dfrac{B/H}{b/h}$

conventional mapping photos
$B/H \sim 0.6$,
typical person $b/h \sim 0.15$
} V.E. ~ 4x

in a stereo workstation, depth appears "stretched"

⇒ does not affect measurements + models
in fact is used to increase sensitivity of height measurements.



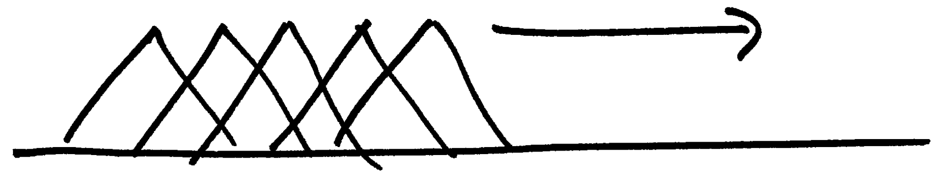


L : overlap dimension

R_F : forward overlap fraction 0.6, 60%

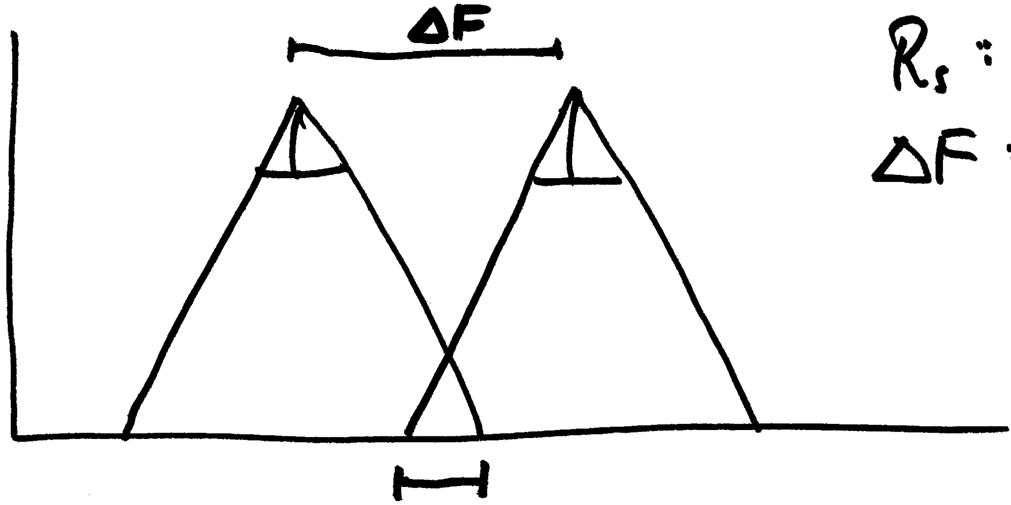
$L = R_F \cdot W$

$B = (1 - R_F)W$, $\frac{w}{W} = \frac{f}{H} = \text{scale}$



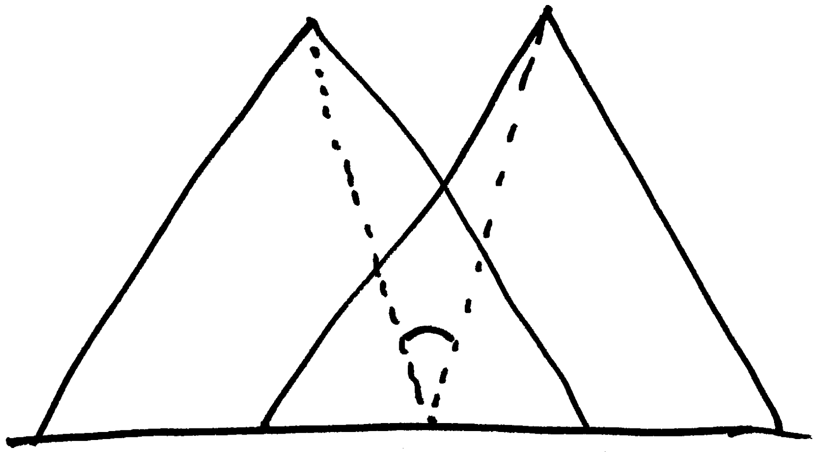
R_s : side overlap fraction 30%, 25%

$\Delta F = W(1 - R_s)$

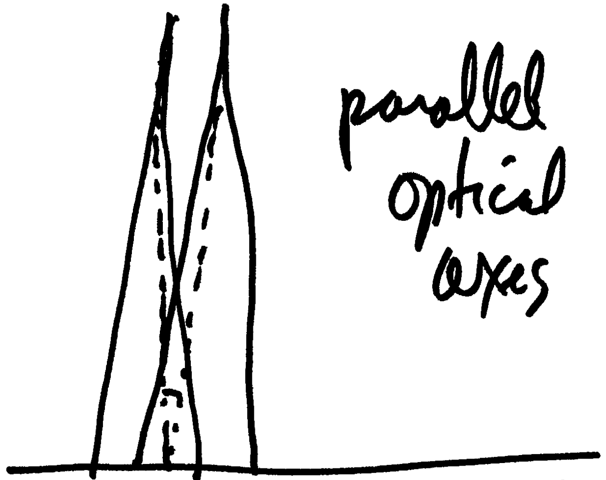


B : base along flight line

ΔF : spacing between flightlines



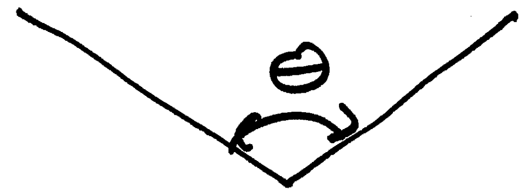
60% overlap with wide F.O.V. camera

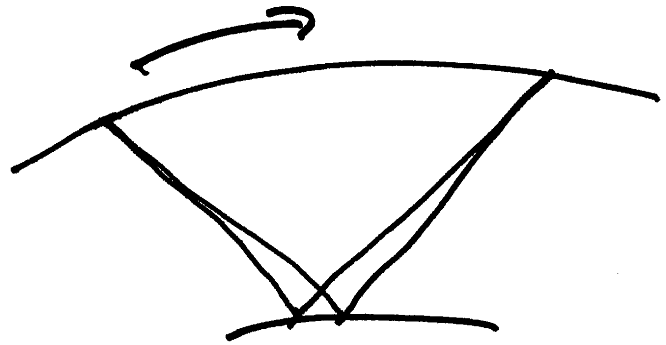


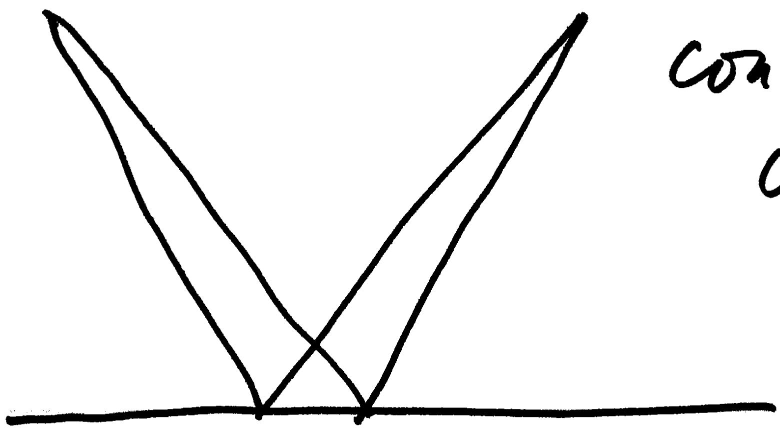
parallel optical axes

60% overlap with narrow F.O.V. camera

important factor for height precision is







convergent optical axes

small intsc angle : easy stereo } large intsc angle difficult stereo

height precision increases (σ gets smaller) as intersection angle θ gets larger

planimetric precision moves in the opposite way !