

u v w

$$x_i = P X_i$$

$$x_i \times P X_i \equiv [x]_x P X$$

$$\begin{bmatrix} 0 & -w & v \\ w & 0 & -u \\ -v & u & 0 \end{bmatrix} \begin{bmatrix} P_1^T X \\ P_2^T X \\ P_3^T X \end{bmatrix} = 0$$

$\begin{matrix} 1 \times 4 & \swarrow & \searrow \\ & P_1^T X & P_2^T X \\ & \nwarrow & \swarrow \\ & 3 \times 4 & 4 \times 1 \end{matrix}$

$$[x]_x P X$$

$$\begin{bmatrix} 0 & -w X^T & v X^T \\ w X^T & 0 & -u X^T \\ -v X^T & u X^T & 0 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ P_3 \end{bmatrix} = 0$$

$$\begin{bmatrix} 0_{4 \times 1} & -x & -y & -z & -1 & v_x & v_y & v_z & v \\ x & y & z & 1 & 0_{4 \times 1} & -u_x & -u_y & -u_z & -u \end{bmatrix}$$

2 x 12

$$A P = 0 \quad 2N \times 1$$

$\begin{matrix} \swarrow & \searrow \\ 2N \times 12 & 12 \times 1 \end{matrix}$

$$\omega = K^{-T} K^{-1} \xrightarrow{\text{Cholesky Decomposition}} L L^T$$

$$v_i^T \omega v_j = 0$$

$$K = L^{-T} \text{ (normalized } K_{33}=1)$$

↳ symmetric positive

$$K = \begin{bmatrix} f & 0 & x \\ 0 & f & y \\ 0 & 0 & 1 \end{bmatrix}$$

$$\omega = \begin{bmatrix} \omega_1 & 0 & \omega_2 \\ 0 & \omega_1 & \omega_3 \\ \omega_2 & \omega_3 & \omega_4 \end{bmatrix}$$

$$\omega_1 : \omega_2 : \omega_3 : \omega_4$$

3 DoF

$$v_1, v_2, v_3 \rightarrow (v_1, v_2), (v_1, v_3), (v_2, v_3)$$

$$v_i^T \omega v_j = 0$$

$1 \times 3 \quad 3 \times 3 \quad 3 \times 1$

$$A x = 0$$

$\underbrace{x_i x_j + y_i y_j}_{\text{red}} \quad \underbrace{x_i + x_j}_{\text{blue}} \quad \underbrace{y_i + y_j}_{\text{orange}} \quad \underbrace{1}_{\text{green}}$

$$\omega v_j = \begin{bmatrix} \omega_1 x_j + \omega_2 \\ \omega_1 y_j + \omega_3 \\ \omega_2 x_j + \omega_3 y_j + \omega_4 \end{bmatrix} [x_j \quad y_j \quad 1]$$

$$\underbrace{\omega_1 x_i x_j}_{\text{red}} + \underbrace{\omega_2 x_i}_{\text{blue}} + \underbrace{\omega_1 y_i y_j}_{\text{red}} + \underbrace{\omega_3 y_i}_{\text{orange}} + \underbrace{\omega_2 x_j}_{\text{blue}} + \underbrace{\omega_3 y_j}_{\text{orange}} + \underbrace{\omega_4}_{\text{green}}$$

$$x \equiv H x_{conic}$$

$\begin{matrix} 3 \times 1 & \nearrow \\ 3 \times 1 & \downarrow \\ & 3 \times 3 \end{matrix}$

$$(0,0) (0,1) (1,0) (1,1)$$

$$h_1^T \omega h_2 = 0$$

$\begin{matrix} 3 \times 3 \\ 1 \times 3 & 3 \times 1 \end{matrix}$

$$\omega = \begin{bmatrix} a & b & d \\ b & c & e \\ d & e & f \end{bmatrix}$$

$$h_1^T \omega h_1 = h_2^T \omega h_2$$

$$A \omega = 0$$

$\begin{matrix} 3 \times 5 & 5 \times 1 \end{matrix}$

$$U D V^T \rightarrow \text{last row}$$

$$[x_i]_x H x_{conic} = 0$$

$\begin{matrix} 3 \times 3 & 3 \times 1 \end{matrix}$

$$\begin{bmatrix} 0 & -1 & y \\ 1 & 0 & -x \\ -y & x & 0 \end{bmatrix} \begin{bmatrix} h_1 & x_c \\ h_2 & x_c \\ h_3 & x_c \end{bmatrix}$$

$\begin{matrix} 3 \times 3 & 3 \times 1 \end{matrix}$

$$A h = 0$$

$$\begin{bmatrix} -h_2 x_c + x h_3 x_c \\ h_1 x_c - x h_3 x_c \\ -y h_1 x_c + x h_3 x_c \end{bmatrix} = 0$$

$$-h_4 x_c + -h_5 y_c - h_6 + y (h_7 x_c + h_8 y_c + h_9) = 0$$

$$0 \quad 0 \quad 0 \quad -x_c \quad -y_c \quad -1 \quad y x_c \quad y y_c \quad y = 0$$

$$\omega = K^{-T} K^{-1}$$

$$8 \times 9 \quad 9 \times 1$$

$$8 \times 1$$

$$h_9 = 1$$

$$h_1^T w h_2 \leq 0$$

$$\begin{bmatrix} h_1 & h_4 & h_7 \end{bmatrix}_{1 \times 3} \begin{bmatrix} w_1 & w_2 & w_3 \\ w_4 & w_5 & w_6 \\ w_7 & w_8 & w_9 \end{bmatrix}_{3 \times 3} \begin{bmatrix} h_2 \\ h_5 \\ h_8 \end{bmatrix}_{3 \times 1}$$

$$\begin{bmatrix} w_1 h_2 + w_2 h_5 + w_3 h_8 \\ w_4 h_2 + w_5 h_5 + w_6 h_8 \\ w_7 h_2 + w_8 h_5 + w_9 h_8 \end{bmatrix}_{3 \times 1}$$

$$h_1 [w_1 h_2 + w_2 h_5 + w_3 h_8] + h_4 [w_4 h_2 + w_5 h_5 + w_6 h_8] + h_7 [w_7 h_2 + w_8 h_5 + w_9 h_8] \leq 0$$

$$h_1 h_2 \rightarrow w_1$$

$$h_1 h_5 \rightarrow w_2$$

$$h_1 h_8 \rightarrow w_3$$

$$h_4 h_2 \rightarrow w_4$$

$$h_4 h_5 \rightarrow w_5$$

$$h_4 h_8 \rightarrow w_6$$

$$h_7 h_2 \rightarrow w_7$$

$$h_7 h_5 \rightarrow w_8$$

$$h_7 h_8 \rightarrow w_9$$

$$\begin{matrix} w_1 & w_2 & w_3 \\ w_4 & w_5 & w_6 \\ w_7 & w_8 & w_9 \end{matrix}$$

$$h_1 h_2$$

$$h_1 h_5 + h_4 h_2$$

$$h_4 h_2$$

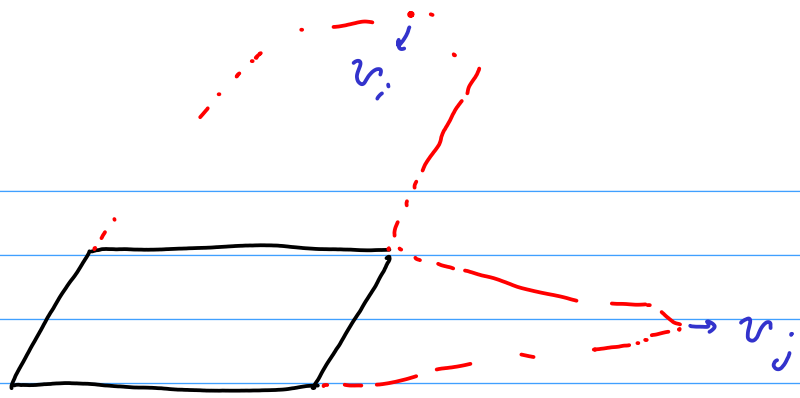
$$h_1 h_8 + h_7 h_2$$

$$h_4 h_8 + h_7 h_5$$

$$h_7 h_8$$

Normalize $\leftarrow n = d_i \times d_j$
 so that $\|n\| = 1$

$$d = K^{-1} v$$



$$\underbrace{n^T}_{\text{normal}} \underbrace{X}_{\text{distance}} + a = 0$$

We should get ref point and assign depth to it

$$X_{\text{ref}} = \lambda K^{-1} x_{\text{ref}} \rightarrow a = -n^T X_{\text{ref}}$$

To Reconstruct $n^T \underbrace{X}_{\lambda K^{-1} x} + a = 0 \rightarrow \lambda (n^T K^{-1} x) + a = 0$

$$\lambda = \frac{-a}{n^T K^{-1} x}$$

for Connected Plans x will come from the shared corner
 or any point in the shared edge