Recap

coimage of point. a line.

$$\lambda_i x_i = \Pi_i X$$

$$l_i^T \Pi_i x_0 = l_i^T \Pi_i V = 0.$$

$$I \vec{\lambda} = \Pi X \quad I \in \mathbb{R}^{3m \times m}$$

$$\lambda \in \mathbb{R}^m$$

$$\Pi \in \mathbb{R}^{3m \times 4}$$

$$X \in \mathbb{R}^4$$

$$W_l = \begin{pmatrix} l_1^T \Pi_1 \\ \vdots \\ l_m^T \Pi_m \end{pmatrix} \in \mathbb{R}^{m \times 4}$$

- $N_p \equiv (\Pi, I) \in \mathbb{R}^{3m \times (m+4)}$

  $m \geq 2$: $\operatorname{rank}(N_p) \leq m+3$

- $\operatorname{rank}(W_l) \leq 2$.
- $W_l D_l \Rightarrow M_l$

  $\operatorname{rank}(M_l) \leq 1$

  $\operatorname{rank}(M_l) = \underline{\underline{0}}, \underline{\underline{1}}, \underline{\underline{2}}$

- $\underline{I^\perp} \underset{\uparrow}{\underline{I}} = 0 \Rightarrow \underbrace{I^\perp \Pi}_{W_p} X = 0$

  $W_p \in \mathbb{R}^{3m \times 4}$

  $\operatorname{rank}(W_p) \leq 3$.

- Assume $\Pi_1 = (I, 0)$.

$$W_p D_p = \begin{pmatrix} \hat{x}_1 x_1 & 0 \quad 0 \quad 0 \quad 0 \\ \vdots & \boxed{M_p} \\ \hat{x}_m R_m x_1 & \end{pmatrix} \in \mathbb{R}^{3m \times 5}.$$

$\operatorname{rank}(M_p) \leq 1 \quad \operatorname{rank}(2)$.

- $\begin{pmatrix} a_1 & b_1 \\ \vdots & \vdots \\ a_n & b_n \end{pmatrix}$ $a_i b_j^T - a_j b_i^T = 0$ ⇒ trilinear constraint.

- rank$(M_p) = 0, 1, 2$.
- trilinear constraint ⇒
  1) λ_1 is known. ⇒ get $\Pi_i = (R_i, T_i)$.
  2) Π_i is known ⇒ get λ.

---

1. a). If $\xi = 0$.

$$T(g(0), p) = p$$

$$\begin{aligned} \tau(0, x) &= \pi(p') = \pi(T(g(0), p)) \\ &= \pi(p) \\ &= \pi(\pi^{-1}(x, Z_1(x))) \\ &= x \end{aligned}$$

$$\begin{aligned} r_i(0) &= I_2(\tau(0, x)) - I_1(x) \\ &= I_2(x) - I_1(x) \end{aligned}$$

1 b) $\boxed{\begin{aligned} p &= \pi^{-1}(x, Z_1(x)) \\ p' &= T(g(\xi), p) \\ x' &= \pi(p') \end{aligned}}$ $r(\xi) = I_2(x') - I_1(x)$

$$\frac{\partial r}{\partial \xi}$$