HC

(X_H, Y_H, Z_H, W) 9/23/18 - 1

CART

(X, Y, Z) $\quad X = X_H / W$

HC $(1,2,3,4) \rightarrow$ CART $\left(\frac{1}{4}, \frac{2}{4}, \frac{3}{4}\right)$

TRANSLATION IS MATRIX

$D = (3, 4, 5)$

$$M = \begin{pmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$v = (3, 4, 5)$

$M = \begin{pmatrix} 5 \\ 7 \\ 9 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 2 \\ 3 \\ 4 \\ 1 \end{pmatrix}$

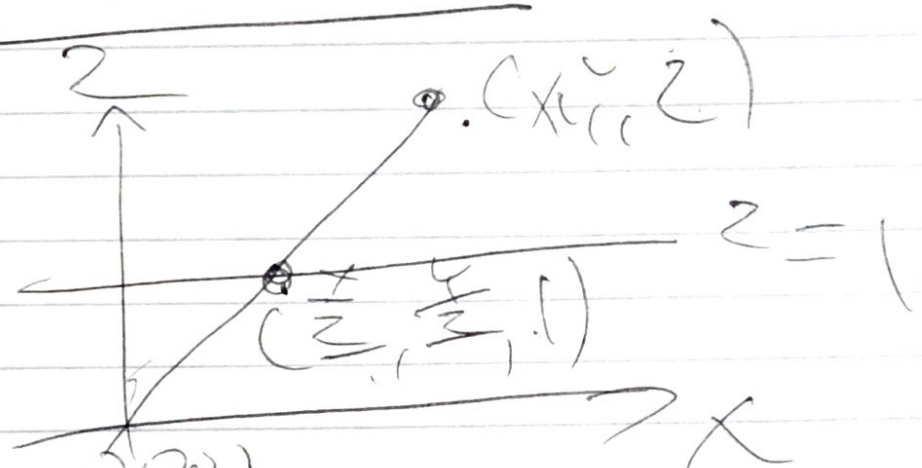
$P = (2\ 3\ 4)$

$P' = (5\ 7\ 9)$

ANY MATRIX MULT STILL WORKS

$\begin{pmatrix} - & - & - & 0 \\ - & - & - & 0 \\ - & - & - & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

PROJECTION



$$\begin{pmatrix} z \\ 3 \\ 4 \\ 4 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} z \\ 3 \\ 4 \\ 1 \end{pmatrix}$$

$$\rightarrow \begin{pmatrix} z & 3/4 & 4/4 \\ 4/4 & 4/4 & 4/4 \end{pmatrix}$$

$$P' \underbrace{STPSRT}_{M} = P$$

$$P' = MP$$

3D ROTATION

4

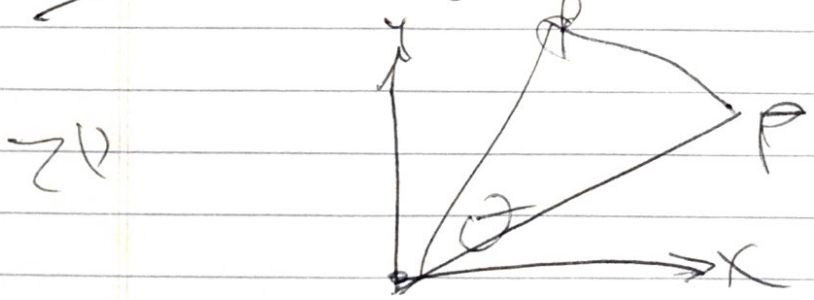
DEFINE RIGID: LENGTHS INVARIANT.

NOT REFLECTION

ORIGIN FIXED

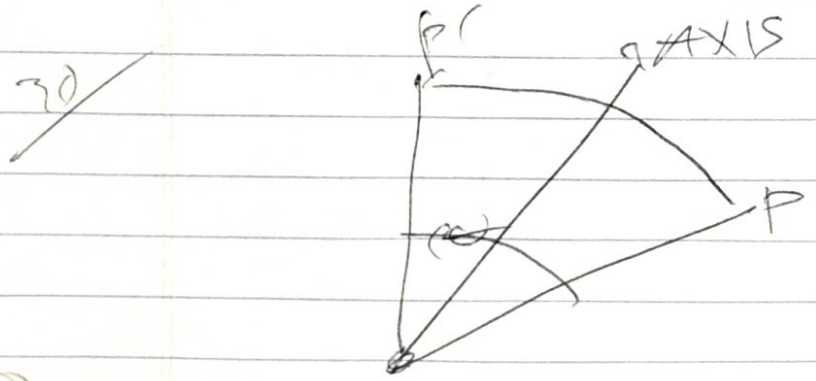
⇒ COULD USE A 3×3 MATRIX MULT.

METHOD 1 VECTORS

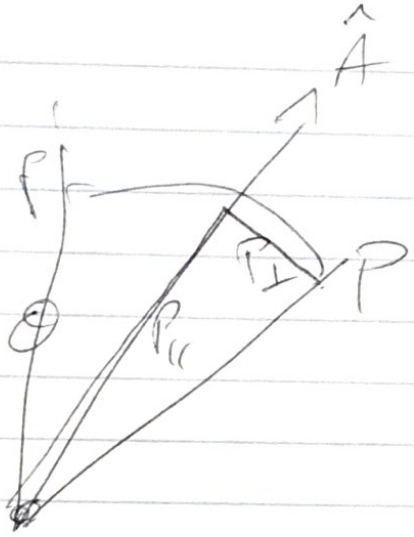


$$\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$$

2D



NOT COMMUTATIVE



$P = P_{\parallel} + P_{\perp}$

$P_{\parallel} = A \cdot P\, A$

$P_{\perp} = P - P_{\parallel}$

IF $A = (0,0,1)$

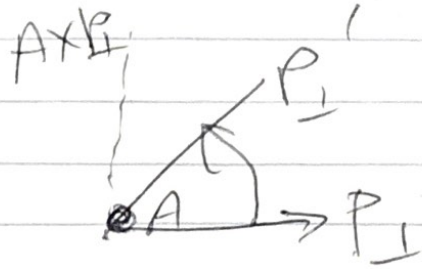
$P = (3,4,5)$

$P_{\parallel}' = P_{\parallel}$

$P_{\parallel} = (0\,0\,5)$

$P_{\perp} = (3,4,0)$

$P_{\perp}$ IS ROTATING IN A PLANE $\perp$ A.



$P_{\perp}' = P_{\perp}\cos\theta + A \times P_{\perp} \sin\theta$

$$p_{\parallel} = A \cdot pA \qquad p_{\perp} = p - p_{\parallel}$$

$$p' = p_{\parallel}' + p_{\perp}'$$

$$= A \cdot pA + p_{\perp} \cos\theta + p_{\perp} \sin\theta \; A \times p_{\perp}$$

$$=$$