

Self - On camera matrices

$$x = P X$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{matrix} P \\ 3 \times 4 \end{matrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

homogeneous
image

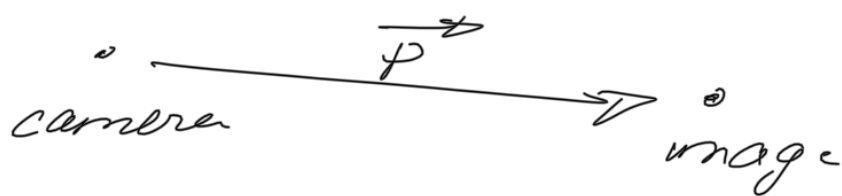
homogeneous
world pt

→ Pin hole

$$\begin{bmatrix} x & y & z \end{bmatrix}^T \rightarrow \begin{bmatrix} \frac{fX}{z} & \frac{fY}{z} \end{bmatrix}^T$$

$$\Rightarrow P = \begin{bmatrix} f & 0 & 0 & 0 \\ 0 & f & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

If camera origin & image origin are different:



$$P = \begin{bmatrix} f & 0 & b_x & 0 \\ 0 & f & b_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

→ In general → three coordinate frames
 ↳ camera
 ↳ image

C_{world}

$$12 = \begin{bmatrix} f & 0 & p_x \\ 0 & f & p_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

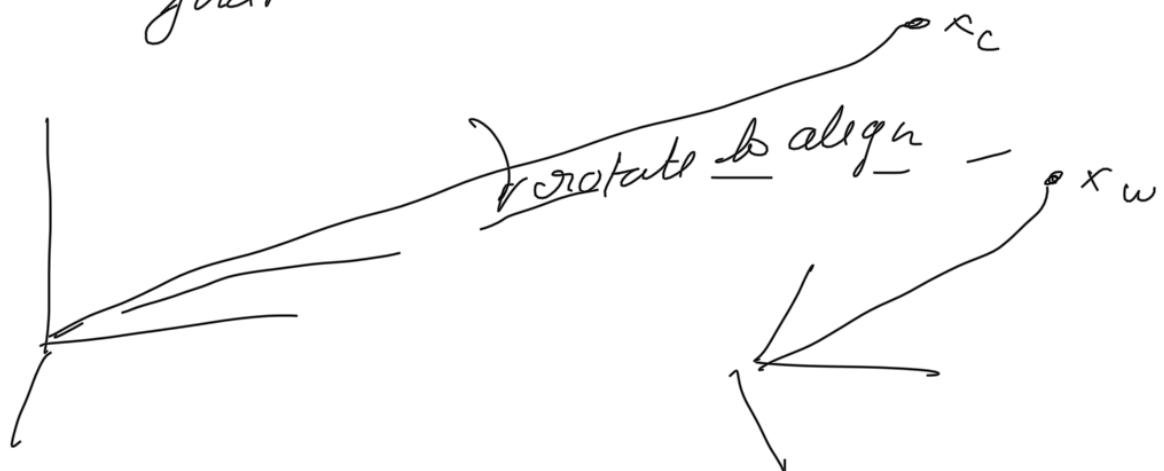
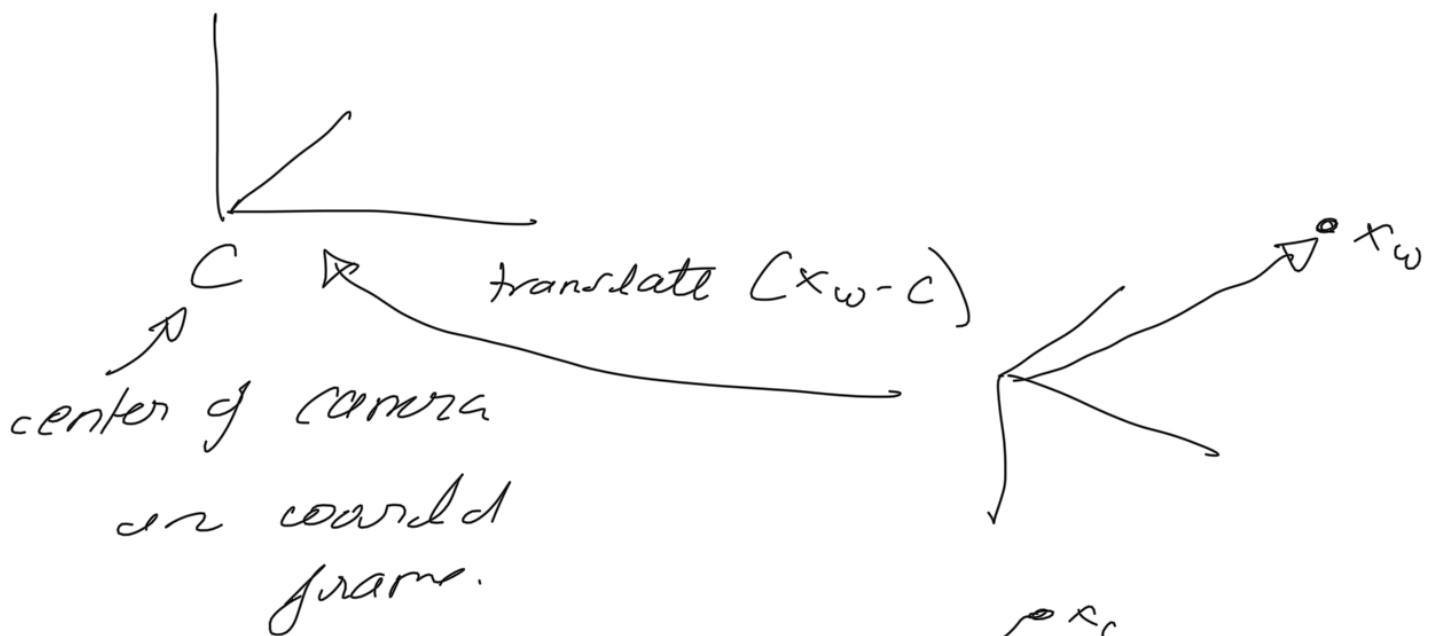
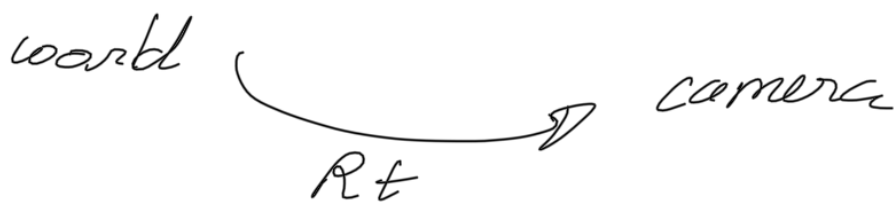
3×3 3×3 3×1

=

$$K [I | 0]$$

\rightarrow calibration matrix

If camera & world coordinate frames are different \rightarrow aligning them



rot $\rightarrow R$

\rightarrow to bring world \rightarrow

to camera. \int

$$x_c = R C x_w - c$$

$$p = K R [I | -C]$$

$$p = K [R | t]$$

Extrinsic

Intrinsic

$t = -RC$