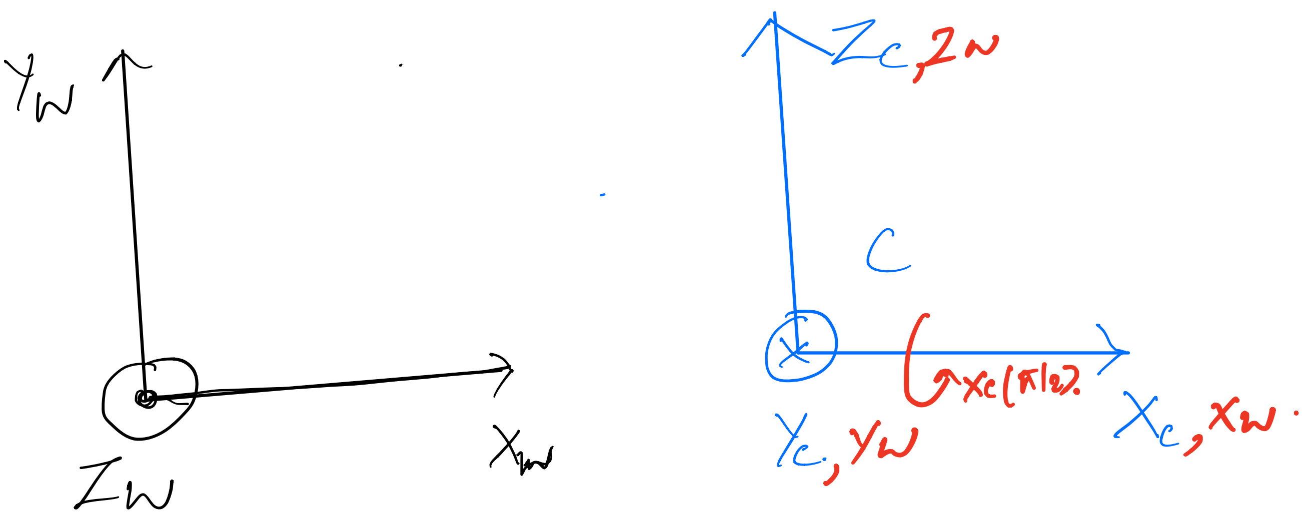
Euler Angles:

Some examples with Euler Angles | Rotation Matrices



R_W^C ?

1) Assume initially that W and C are aligned.

2). The actual W is obtained by

rotating about X_c by $\pi/2$.

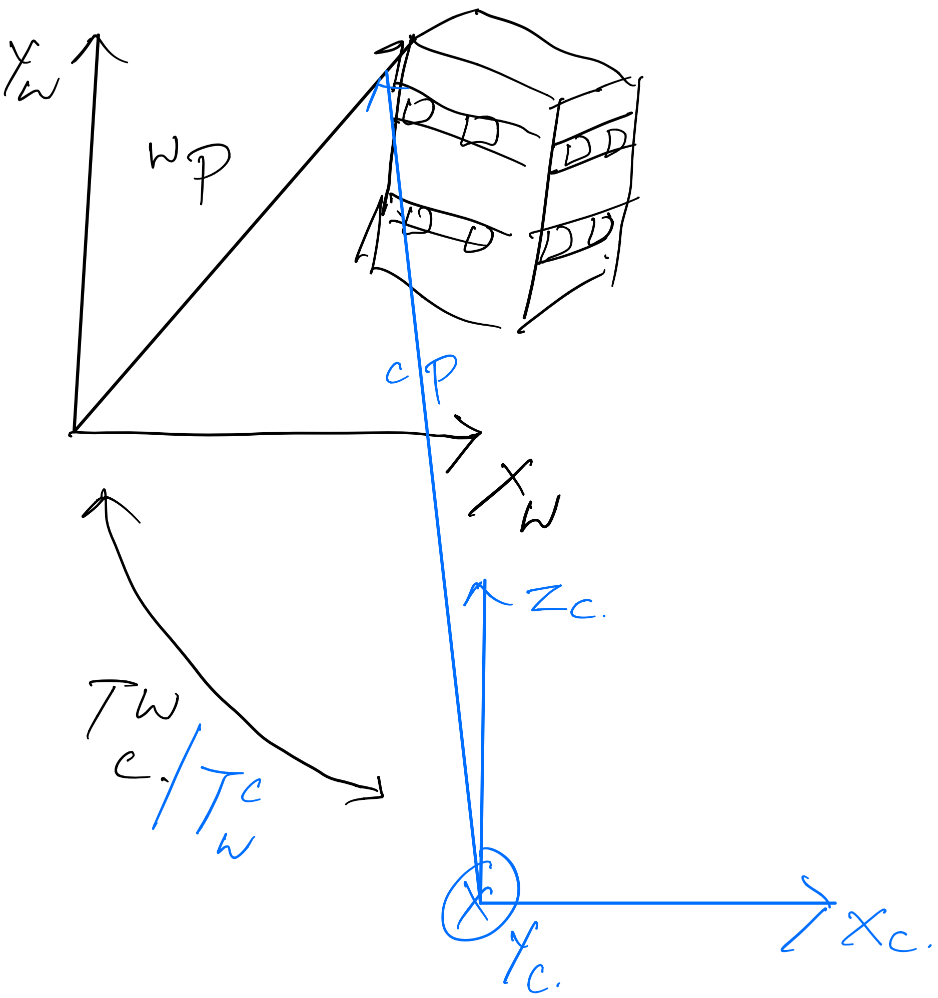
3). $R_W^C = R_{X_c}(\pi/2) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & C\pi/2 & -S\pi/2 \\ 0 & S\pi/2 & C\pi/2 \end{bmatrix}$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & 1 & 0 \end{bmatrix} \longrightarrow (1).$$

Let the world origin W be at $t_W^C = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$ from the camera C.

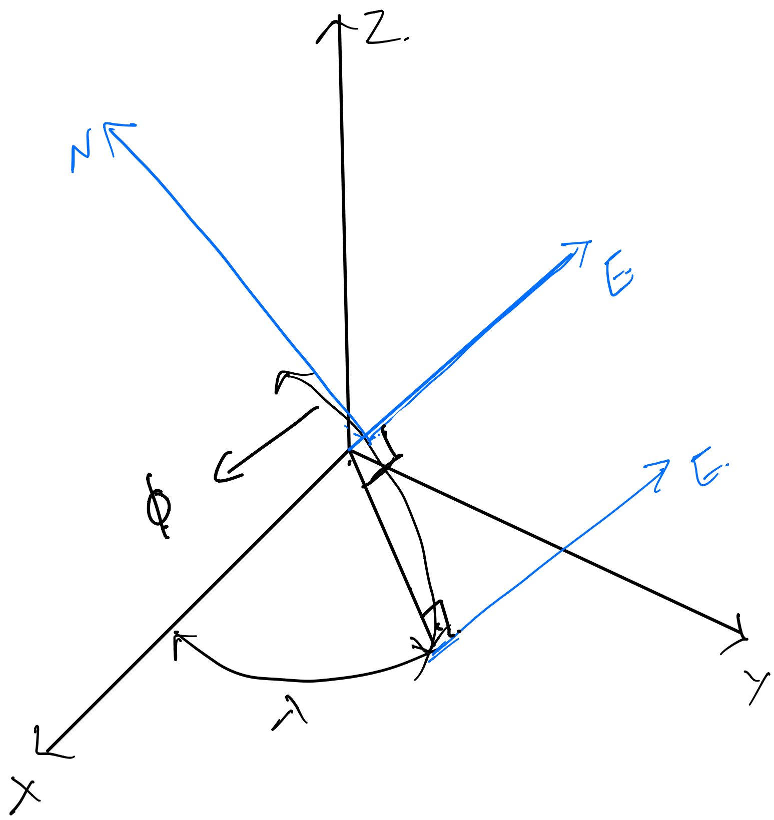
Then $T_W^C = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \longrightarrow (2)$

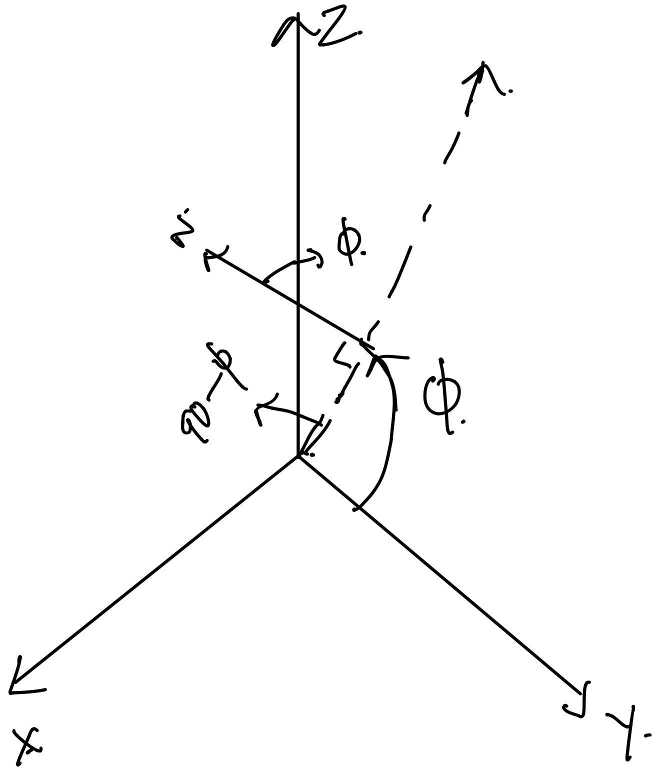
Let ${}^{W}P$ be a point on a building as seen from W



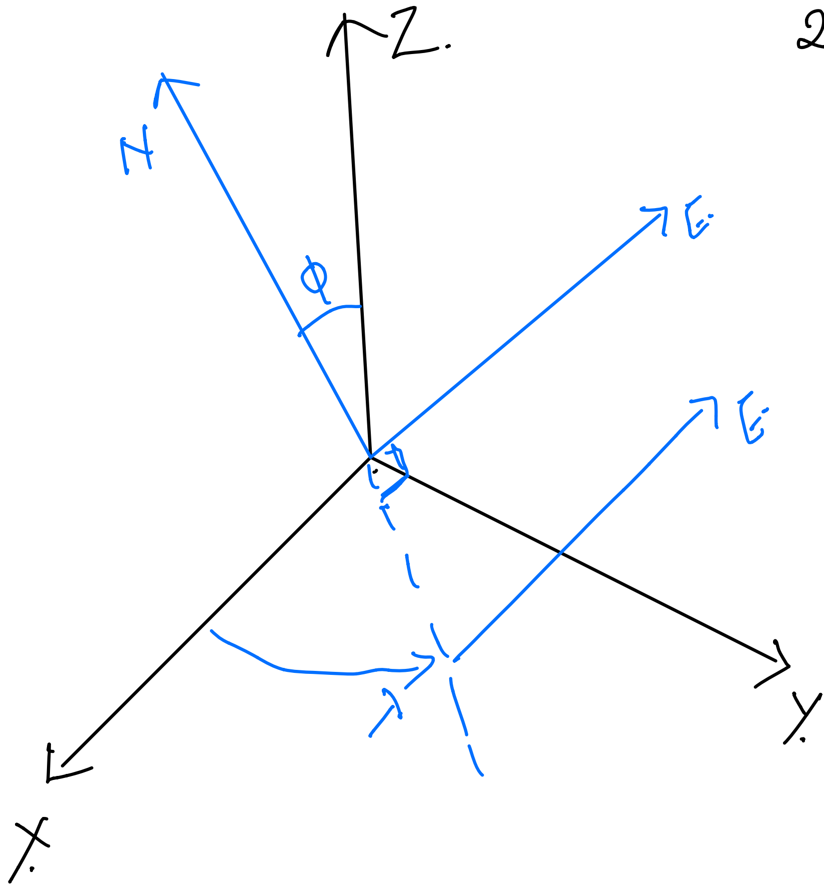
$$\overrightarrow{{}^{C}P} = T^C_W \, \overrightarrow{{}^{W}P}$$

Now note that the camera frame also typically has a rotation about the gravity axes (Y_C). or a yaw. Then R_N^C / T_N^C should take care of that.





1) Rotate $\hat{N}$ about $\hat{E}$ by ϕ to align with Z. Call this new $\hat{N}$ as $\hat{N}_1$.



2) Rotate $\hat{E}$ about $\hat{N}_1$ by $-(90+\lambda)$ to align with $\hat{x}$. Call this E as E_2.

Then $R_{XYZ}^{ENU} = R_{(ENU)_1}^{ENU} \, R_{(ENU)_2}^{(ENU)_1}$

$(ENU)_2 \equiv XYZ.$

$$R_{XYZ}^{ENU} = R_E(\phi) \cdot R_{N_1}(-(90+\lambda)).$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & c\phi & -s\phi \\ 0 & s\phi & c\phi \end{bmatrix} \begin{bmatrix} C(-90-\lambda) & 0 & S(-(90+\lambda)) \\ 0 & 1 & 0 \\ S(90+\lambda) & 0 & C(-(90+\lambda)) \end{bmatrix}$$

$\longrightarrow (3).$