Date
Page

$$\underset{(3\times1)}{x} = \underset{(3\times4)}{P}\ \underset{(4\times1)}{X}$$

$$x = K\,R\,[I \mid -X_0]\,X$$

$$R^T K^{-1} x = [I \mid -X_0]\,X$$

Projecting the world origin onto the image plane with ~~Know~~ Known 3D 2D corres pondance.

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & -t_x \\ 0 & 1 & 0 & -1.65 \\ 0 & 0 & 1 & -t_z \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} u/w \\ v/w \\ 1 \end{bmatrix}$$

here (u/w) & (v/w) are the Known pixel locations of the world origin

$$\left(\frac{u}{w}, \frac{v}{w}\right) = (P_x, P_y)$$

$$\begin{bmatrix} P_x \\ P_y \\ 1 \end{bmatrix} = \begin{bmatrix} -t_x \\ -1.65 \\ -t_z \end{bmatrix} = \begin{bmatrix} -t_x / -t_z \\ -1.65 / -t_z \\ 1 \end{bmatrix}$$

$$P_x = \frac{t_x}{t_z} \quad ; \quad P_y = \frac{1.65}{t_z}$$

$$t_x = P_x t_z \leftarrow t_z = \frac{1.65}{P_y}$$

$\hookrightarrow$ ② $\hookrightarrow$ ①

Translation is determined from equation ① and ② and we obtain the complete projection matrix.

$$P = K\,R\,[\,I \mid -X_0\,]$$

$$= K\,R \left[\begin{array}{ccc|c} 1 & 0 & 0 & -t_x \\ 0 & 1 & 0 & -1.65 \\ 0 & 0 & 1 & -t_z \end{array}\right]$$

→ from ①

→ from ②.

Now for other points around the car project them to image plane.