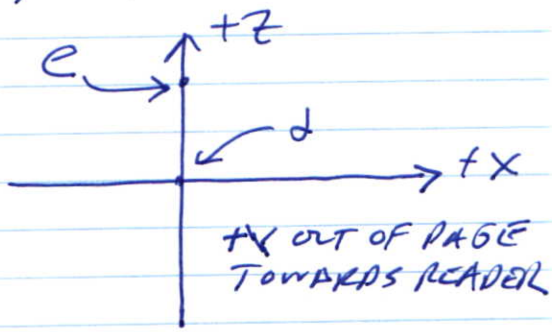
# CMCS 427 CAMERA MATRIX EXAMPLES

These examples show:

a) Computing a camera matrix

b) Testing a computation by using simple values

## Example 1: CAMERA AT (0,0,100)




Set $e = at = (0,0,100)$

$d = \text{lookAt} = (0,0,0)$

$up = \langle 0,1,0 \rangle$

Now $z_c = e - d = \langle 0,0,100 \rangle$

$\bar{z}_c = \langle 0,0,1 \rangle$

$\bar{x}_c = \bar{up} \times \bar{z}_c = \begin{vmatrix} i & j & k \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} = \langle 1,0,0 \rangle$

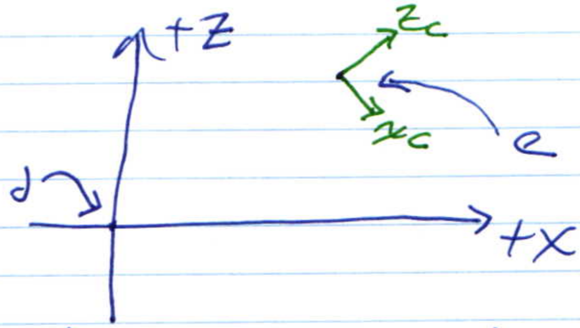
$\bar{y}_c = \bar{z}_c \times \bar{x}_c = \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{vmatrix} = \langle 0,1,0 \rangle$

And $C = \begin{bmatrix} x_c & y_c & z_c & e \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & +100 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

So $C^{-1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -100 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ by inspection

If $C = \begin{bmatrix} R & T \\ 000 & 1 \end{bmatrix}$ then $C^{-1} = \begin{bmatrix} R^T & -R^T \cdot T \\ 000 & 1 \end{bmatrix}$

## Example 2: CAMERA OUT DIAGONAL




Set $e = at = (100, 0, 100)$

$d = lookAt = (0, 0, 0)$

$up = \langle 0, 1, 0 \rangle$

Now $z_c = e - d = \langle 100, 0, 100 \rangle$

$\bar{z}_c = \langle +.71, 0, +.71 \rangle$

$\vec{x}_c = up \times z_c = \begin{vmatrix} i & j & k \\ 0 & 1 & 0 \\ .71 & 0 & .71 \end{vmatrix} = \langle +.71, 0, -.71 \rangle$ $\quad (.71 \cong \frac{1}{\sqrt{2}})$

$\bar{y}_c = \bar{z}_c \times \bar{x}_c = \begin{vmatrix} i & j & k \\ .71 & 0 & .71 \\ +.71 & 0 & -.71 \end{vmatrix} = \langle 0, -(-\tfrac{1}{2} + -\tfrac{1}{2}), 0 \rangle = \langle 0, 1, 0 \rangle$

And

$$C = \begin{bmatrix} x_c & y_c & z_c & e \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} +.71 & 0 & +.71 & 100 \\ 0 & 1 & 0 & 0 \\ -.71 & 0 & +.71 & 100 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$C^{-1} = \begin{bmatrix} x_c & -x_c \cdot e \\ y_c & -y_c \cdot e \\ z_c & -z_c \cdot e \\ 0 \; 0 \; 0 & 1 \end{bmatrix} = \begin{bmatrix} R^T & -R^T \cdot T \\ 0 \; 0 \; 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} +.71 & 0 & -.71 & -\langle .71, 0, -.71 \rangle \cdot \langle 100, 0, 100 \rangle \\ 0 & 1 & 0 & -\langle 0, 1, 0 \rangle \cdot \langle 100, 0, 100 \rangle \\ +.71 & 0 & +.71 & -\langle +.71, 0, +.71 \rangle \cdot \langle 100, 0, 100 \rangle \\ 0 & 0 & 0 & \end{bmatrix}$$

$$= \begin{bmatrix} +.71 & 0 & -.71 & 0 \\ 0 & 1 & 0 & 0 \\ +.71 & 0 & +.71 & -100 \times \sqrt{2} \end{bmatrix}$$