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 \( e = at = (0, 0, 100) \)
\( d = 100kA + e, (0, 0, 0) \)
\( up = \langle 0, 1, 0 \rangle \)

Now \( \mathbf{z}_e = e - d = \langle 0, 0, 100 \rangle \)
\( \mathbf{z}_e = \langle 0, 0, 1 \rangle \)
\( \mathbf{x}_e = up \times \mathbf{z}_e = \begin{vmatrix} i & j & z_e \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{vmatrix} = \langle 1, 0, 0 \rangle \)

\( \mathbf{y}_e = \mathbf{z}_e \times \mathbf{x}_e = \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{vmatrix} = \langle 0, 1, 0 \rangle \)

And \( \mathbf{C} = \begin{bmatrix} \mathbf{x}_e & \mathbf{y}_e & \mathbf{z}_e & \mathbf{e} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & +100 \\ 0 & 0 & 0 & 1 \end{bmatrix} \)

So \( \mathbf{C}^{-1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -100 \\ 0 & 0 & 0 & 1 \end{bmatrix} \) by inspection.

If \( \mathbf{C} = \begin{bmatrix} R & T \\ 0 & 0 & 0 \end{bmatrix} \) then \( \mathbf{C}^{-1} = \begin{bmatrix} R^T & -R^T \cdot T \\ 0 & 0 \end{bmatrix} \)
Example 2: CAMERA ORT DIAGONAL

Set $\mathbf{e} = \mathbf{ct} = (100, 0, 100)$
$\mathbf{t} = t \mathbf{u}$
$\hat{\mathbf{t}} = (0, 0, 0)$
$\theta = \langle 0, 1, 0 \rangle$

Now

$\mathbf{z}_c = \mathbf{c} - \mathbf{t} = (000, 0, 100)$
$\mathbf{z}_c = \langle t, 0, 0 \rangle$

$\mathbf{x}_c = \mathbf{op} \times \mathbf{z}_c = \begin{bmatrix} 0 & 1 & 0 \\ t & 0 & 0.71 \\ 0.71 & 0.71 \end{bmatrix} = \langle t, 0, -0.71 \rangle$

$\mathbf{v}_c = \mathbf{z}_c \times \mathbf{x}_c = \begin{bmatrix} 0 & 1 & 0 \\ t & 0 & 0.71 \\ 0.71 & 0.71 \end{bmatrix} = \langle 0, -(\frac{t}{2} - \frac{t}{2}), 0 \rangle$

And

$C = \begin{bmatrix} \mathbf{x}_c & \mathbf{v}_c & \mathbf{z}_c & \mathbf{e} \end{bmatrix} = \begin{bmatrix} t & 0 & t & 100 \\ 0 & 1 & 0 & 0 \\ -0.71 & 0 & t & 100 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$C^{-1} = \begin{bmatrix} \mathbf{x}_c & -\mathbf{v}_c & \mathbf{z}_c & -\mathbf{e} \end{bmatrix} = \begin{bmatrix} R^T & -R^T F \\ 0 & 0 & 0 & 1 \end{bmatrix}$

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

$= \begin{bmatrix} t & 0 & -t & \text{det} \begin{bmatrix} 100 & 0 \\ 0 & 1 \end{bmatrix} \cdot \sqrt{2} \\ 0 & 1 & 0 & 0 \\ t & 0 & t & \text{det} \begin{bmatrix} 100 & 0 \\ 0 & 1 \end{bmatrix} \cdot \sqrt{2} \end{bmatrix}$