

The camera transformation transforms the entire scene into a view volume where it can be captured and projected onto a plane.

Before a camera transform, a user will specify the following:

- The eye position  $e$ 
  - The position of the camera origin
- The gaze direction  $g$ 
  - A vector shooting out of the lense
- The view-up vector  $t$ 
  - A vector pointing from the middle of the camera lens, towards the top of the camera

Essentially, this is a coordinate system transfer to system  $\langle \mathbf{u}, \mathbf{v}, \mathbf{w} \rangle$

$\langle \mathbf{u}, \mathbf{v}, \mathbf{w} \rangle$  is constructed from the following steps (see [Creating an Orthogonal Coordinate System](#)):

1. Move  $e$  to the origin
2.  $\mathbf{w} = -\frac{\mathbf{g}}{\|\mathbf{g}\|}$
3.  $\mathbf{u} = \frac{t \times \mathbf{w}}{\|t \times \mathbf{w}\|}$
4.  $\mathbf{v} = \mathbf{w} \times \mathbf{u}$

$$M_{cam} = \begin{pmatrix} u & v & w & e \\ & & & 1 \end{pmatrix}^{-1} = \begin{pmatrix} x_u & y_u & z_u & \\ x_v & y_v & z_v & \\ x_w & y_w & z_w & \\ & & & 1 \end{pmatrix} \begin{pmatrix} 1 & & & -x_e \\ & 1 & & -y_e \\ & & 1 & -z_e \\ & & & 1 \end{pmatrix}$$